DRAFT

Economic Assessment of Managing Coastal Erosion and Shore Protection

Prepared by
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Prepared for
Coastal Hazard Management Plant
New Jersey's Shoreline Future

White Paper

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EXECUTIVE SUMMARY

PRIMER ON ECONOMIC MEASURES & ECONOMIC METHODS:

ECONOMIC MEASURES:

National Income Accounting measures of aggregate economic activity are usually referred to as GDP (Gross Domestic Product) or GNP (Gross National Product). These measures represent the total value of all final goods and services produced in an economy for a given time period, usually a year. Because prices can change over time, the above measures must be adjusted to yield real GDP (gdp), real GNP (gnp), which then represent the value of all final goods and services produced in an economy in terms of constant dollars. As such, changes in gdp/gnp will now reflect changes in real output. Because only final goods and services are considered rather than including sales of used goods and sales of intermediate goods, measures of GDP avoid the problem of double-counting economic activity, a main advantage of these measures; this report will treat national accounting measures as representing measures of "true" economic activity.

Economic impacts are not to be confused with economic benefits, they represent different measures of economic activity. Impacts measure the amount of aggregate economic activity usually in terms of sales, income, employment, and sometimes tax revenues that are associated with some type of change to the economy (structural change - plant closing, reduced demand) or policy change (proposed regulation). Many times they are based on multipliers that not only account for direct effects (effects on primary and secondary sectors only), but also indirect and induced effects. Most individuals are familiar with "expenditure impacts," reported in the news media, that is, impacts of consumer/tourism spending. Measures of economic activity as represented by economic impacts involve double-counting when compared to the true measure of aggregate economic activity, GDP; impact measures overstate the true measure of economic activity (GDP). Without evidence of the magnitude of the error involved (the magnitude that impacts overstate GDP) one must exercise caution in the interpretation and use of these measures. Above all they should not be used alone, but in conjunction with other measures in economic justifications of economic development, promotion, etc.

Economic benefits in the context of economic welfare theory are associated with the monetary value of specific measures of changes in economic welfare. These measures are associated with losses or gains in economic welfare and represent lost economic value and gains in economic value, respectively. In the production sector, the measure of lost (gains in) economic value is economic rents (or simply rents), i.e., the reduction (gains) in profits and producer surplus. Producer surplus is a measure of the net economic value to the producer from the production and sale of goods and services. In the consumption sector, a measure of lost (gains in) economic value is the reduction (gain) in consumer surplus, a monetary surplus that accrues to the consumer over and above expenditures from consumption of a good. It represents a net economic value that accrues to consumers from consumption activities. Any reduction (gain) in it can be considered a loss (gain) in economic value. Aggregate economic benefits are the sum of changes in the value of economic welfare to all agents involved (e.g., consumer and producer). Net benefits are the difference between economic benefits (both direct and indirect) that would accrue to a project and the costs of implementing the project.

Economic benefits in the context of Cost-Benefit Analysis represent different measures compared to those of welfare economics. Here, benefits refer to all gains in economic value (welfare part) and gains in economic activity (e.g., increases in sales, income, employment, etc.) that directly and indirectly result from the proposed project. Cost-savings are sometimes included in CBA benefit measures. Hence, benefits in a CBA context comprise economic value and economic impact benefit measures. However, care must be exercised to avoid double-counting of benefit measures.

ECONOMIC METHODS:

Cost-Effectiveness Analysis concerns the minimum cost option to achieve a given objective. It ignores benefits and does not address economic rationale to achieve a given objective. It is appropriate when considering how a project can be implemented in the least expensive way. The procedure is to estimate all costs for a particular option over time, discount these costs, and then sum the discounted costs (discounted costs represent the total cost in today's dollars); the sum of discounted costs is referred to as present value of costs. The decision criterion is to select that project with the smallest present value of costs over time.

Cost-Benefit Analysis (CBA) is the primary method in which both the benefits and costs associated with a project are considered. It is based on economic justifications in determining the implementation of a project; that is, whether the outcome of a project is worth the costs of achieving it. Here the analyst must identify and then measure all possible benefits and costs associated with the presence of the project as opposed to a situation without the project. This technique has two variations commonly used. One is to examine the difference among benefits and costs (benefits less costs) for each time period, discount it, and then sum it, giving the present value of net benefits over time. The present value of net benefits is the appropriate measure for comparing projects over time given equal scale (size) and time period. The decision criterion is to select that project that yields the maximum present value of net benefits over time. The second version is the B/C ratio, where the discounted sum of benefits is divided by the sum of discounted costs. When benefits equal costs this ratio will equal 1. The decision criterion is to select that project that yields the maximum B/C ratio. The use of this ratio is quite controversial even among economists. Most would agree that selecting a project based solely on the B/C ratio is inappropriate.

ECONOMIC IMPACT ANALYSIS (PUBLIC POLICY ANALYSIS):

Economic Impact Analysis (EIA) also needs clarification. Many applied policy problems and proposed federal regulations use variations of EIA, where it is referred to as Public Policy Analysis. Here the analyst conducts an economic analysis to determine the effects (impacts) of proposed policy changes, where the economic effects associated with the policy are identified and quantified. These effects are not the same as measures.

Economic Input-Output Analysis (I-O) is a specific technique based on an economic input-output model. It uses aggregate measures of economic activity such as sales revenues, income, and employment related to an economy defined by geographic-political boundaries (a state, region, nation). A main feature of this technique is to determine "multipliers" which can be thought of as how changes in primary economic activity translates into final economic activity. Then, one can examine how changes in specific sectors (manufacturing, services, etc.) affect the entire economy in question. I-O analysis was primarily developed to address policy questions such as what are the effects on sales, income, and employment that are associated with some type of change to the economy (structural change - plant closings, reduced demand) or policy change (proposed regulation). Simulation Models

Simulation models are hypothetical computer models written in either primary computer code or in a simulation language to represent (mimic) an actual situation and to then simulate the specific application and changes to it. They have been used in epidemiology to simulate the spread of an actual disease epidemic. It has been used in population ecology to simulate population dynamics and the actual spread of an insect population outbreak and the effects of different control strategies. And some applications have been based on bio-economic models of fisheries.

RISK-RETURN DECISION MODELS

Risk-Return models are from the field of finance and consist of the applications of portfolio theory, risk-mean variance models, and variations of the capital asset pricing model. They are used to decide among tradeoffs between risk and return so as to determine an efficient portfolio of holdings (least risky collection of assets that yield the greatest return) for various risk levels. These models are highly complex and indispensable to analysts and researchers in financial markets.

ECONOMIC ASPECTS OF BEACH USE AND SHORE PROTECTION:

ECONOMIC VALUE OF BEACH USE AND SHORE PROTECTION:

A range of the estimated average net economic value associated with beach protection was derived from several studies for the purposes of this report yielding a low estimate of net economic value of $.35/person per day in 1992 dollars, and a high estimate of $.39/person per day in 1992 dollars; a range from $.35/person per day-trip to $.39/person per day-trip in 1992 dollars.

BEACHES, TOURISM AND ECONOMIC DEVELOPMENT:
Notwithstanding that the nature of tourism in coastal areas can create impact effects (spending effects over and above residents' spending) and possibly contribute to economic development if the tourism effect is large enough, several shortcomings of the papers reviewed weaken their results. These limitations differ by paper and include the following: 1) in several papers projected economic impacts were misinterpreted as aggregate economic activity measures (i.e., GDP); 2) the estimated participation rate of beach use in one paper was based on a misleading procedure that could have introduced an upward bias in the projected estimates of coastal tourism spending and impacts; 3) another paper used statistics from secondary, unofficial sources -- such statistics can be quite misleading and the potential bias and error inherent in secondary source statistics limits the accuracy and usefulness of any research based on such data; 4) other miscellaneous limitations concern the research design, the survey design, interpretation of expenditure data and impact estimates, derivation of impact estimates, sample size and representativeness of sample data. Because projected expenses of beach use can become easily inflated and unrepresentative, the limitations and results found in the studies reviewed raise a general word of caution for research in this area. Future studies should be rigorous, based on accepted research approaches and designs, and use appropriate statistical data, otherwise results will be of little use and will only cloud the issue of the relative economic importance of coastal tourism vis a vis investment in shore protection.

EXPENDITURES AND IMPACTS OF TOURISM ON THE NJ SHORE

The usefulness of the Longwoods study is in the generation of projected direct expenditures discussed above and not in economic impacts. Direct expenditures represent the closest activity to aggregate GNP estimates, because they represent the sales of final goods and services sold, and do not contain double-counting. Regarding coastal tourism, the Barrier Island (long-term beach rentals)(LTBR) component of the Longwoods study represents only one segment of beach travel and underestimates the importance and magnitude of tourism expenditure activity (expenditures other than LTBR) in the coastal region of New Jersey. To develop an estimate of all expenditures associated with beach travel, similar estimates for day trips <u>and</u> other overnight trips (i.e., hotel/motel/resort, campgrounds-private and public, and those that stay with friends/relatives) for the four-coastal counties are necessary. On the basis of the estimated number of trips and the estimated average trip expense, an upper bound for expenditures of all beach-related travel was estimated at $2,095.877 million ($1,917.92 million without gambling (by long-term renters)) for 1993. The Barrier Island (LTBR) component represented 41.74% of the 1993 estimated tourist beach-related expenditures. If this proportion is representative across other years, the three-year (1992-94) estimated average expense for beach trips would account for an estimated $1,887.64 million average/year (45.57%

of the estimated total) and an estimated $1,726.75 million average/year without gambling in 1992 dollars. However, the reader is cautioned in reading too much into these estimates; they were developed for illustrative purposes. Little confidence can be placed in the estimates; such estimates should be developed from a single sample base rather than from two, and should be developed as part of an objective of the travel and tourism studies in the form of a range. The estimates developed are meant to illustrate the point that projected tourism expenses associated with beach trips based on the Barrier Island component are underestimates of such activity, whereas the county-level estimates of the four-coastal counties are overestimates of beach-related economic activity. The derived estimate, $1,887.64 million average/year over the 1992-94 period in 1992 dollars, represents 18% of the four-coastal county three-year average, and 9.8% of the state three-year average (without gambling expenditures the estimate is $1726.75 million/year representing 23.8% of the 4-coastal county 3-year average, and 10.5% of the 3-year state average). In 1993, the LTBR and other beach expenditures for the four coastal counties totaled about $2.0 billion; gambling expenditures at Atlantic City totaled $3.2 billion. Thus, beach-related tourism and recreation plus gambling accounted for more than half of the $9.7 billion of tourism expenditures in the four coastal counties in 1993. These values are estimates from the data reported in the Longwoods study and represent the approximate role of beach recreation and tourism in New Jersey. Further effort should be directed to incorporate beach-related information in future Longwoods studies.

SHORE PROTECTION POLICY ORIENTED STUDIES:

The Cost-Benefit Analysis (CBA) performed in the New Jersey Shore Protection Master Plan (NJSPMP) is basically static, although some attempt was made to incorporate changes that occur over time, namely estimates of future beach use and estimates of future property lost or damaged. No attempt was made to incorporate any other dynamic elements nor the risk associated with the expected outcome of the projects, where one could introduce uncertainty into the derivation of net benefits (benefits less costs). A dynamic analysis would compare and contrast the monetary value of a projects' outcome if completely certain versus that with the presence of uncertainty. In the case of beach protection, possible risk factors could involve such effects as erosion and storm damage that could cause any project from not being 100% completed, uncertainty over available funds to ensure 100% completion of any project over the planning period, and uncertainty over the estimated number of future beach users, and the value of estimated future property structures lost versus protected. Probably the most serious fault is the problem of downward bias in both the cost and benefit estimates which would tend to introduce either an upward bias or a downward bias in the magnitude of the B/C ratio, respectively, distorting the B/C ratio. The net effect is ambiguous, but places concern over the validity and accuracy of the CBA in the NJSPMP.

Policy findings of the ICF (1989) study conducted for the New England/New York Coastal Zone Task Force were the following: 1) "new" development in coastal floodplains was found to be a net cost to governments, "existing" development in many cases was worth

protecting; 2) the "best" policy response was found to depend on the following factors a) the existing level of development, b) costs from damage, and c) magnitude of revenues gained; 2.a) in areas that are relatively less-developed, beach nourishment was found to be a viable policy; 2.b) in areas with high levels of development, protection via dikes was found to be a viable policy where large amounts of property could be damaged and where dike building could be coupled with a policy of halting further development; 3) optimal policies differed over time; and 4) the use of subsidies, e.g., NFIP, was found to have important consequences on development (in the promotion of development).
Policy recommendations offered by ICF (1989) were for two categories, 1) future development, and 2) existing development. Concerning future development, ICF recommended that: 1) continued large-scale development would be a net cost to governments (costs greater than revenues); 2) NFIP should tighten the availability of flood insurance to discourage future development (such action would have an effect similar to one where property owners are charged the full costs of flood insurance); 3) policies should be implemented whereby property owners are charged the full costs of cleanup and repairs; 4) policies should be designed to prohibit reconstruction of structures and land should be rezoned following significant storm damage (e.g., when 50% or more of a structure is damaged); and 5) governments should establish future policies on shore protection and announce these to the public (the idea is that if governments pre-committ to a policy of no provision of shore protection in areas facing "new" development, this will create disincentives for future development and cause property-owners to internalize and bear the full costs of damage and cleanup).

Regarding existing development, ICF admits that policy choice "is not an easy answer," (ICF 1987:60). Recommended policy options were found to depend on development levels; in areas with high levels of development it was recommended that policies protect existing structures, whereas in areas with low levels of development, policies of protection were not recommended, but recommendations of property acquisition, rezoning, tightening of insurance, and having owners assume the full costs of damage and cleanup and accept losses of capital investment in buildings and from losses of the tax base were.

OVERALL SUMMARY:

The basic issue one would like to address concerns whether the deposition of sand on the beach generates tourism and/or economic benefits. One can think of the coastal zone as a kind of "economic engine" in the sense that the coastal zone generates economic activity, such as income, sales, and jobs via tourism and businesses that are water-dependent and/or require to be located in close proximity to the coastal area. The above studies and investigators attempt to address different components of the beach fill - economic activity question. However, because the above studies are based on different research and sampling designs, and have different objectives, the data and results are too fragmented for one to develop reliable estimates of economic activity. This means that the data from the literature are inadequate to develop point estimates of the magnitude of the economic activity associated with the coastal zone. Furthermore, studies that have tried to estimate the level of activity from coastal tourism have tended to ignore the effect of beach nourishment on coastal tourism activity. Data from the above coastal tourism studies are inappropriate to address the issue of whether beach nourishment projects on their own, generate economic activity. In order to isolate and address the issue, investigators must develop studies that incorporate research designs to isolate economic activity dependent on the coastal zone and/or on specific beach nourishment projects. Such studies may require data on economic activity and tourism expenditures that are location-specific, in terms of the relative proximity to the shoreline, and to beach nourishment projects, and be collected on a seasonal basis. Such data is sensitive and generally hard to collect. However, without it one may not be able to advance beyond the current level of analysis and findings.

RECOMMENDATIONS FOR FURTHER STUDY:

a variety of economic techniques such as CBA, Input-Output models, simulation models, risk-return models, and other relevant economic approaches needs to be explored to determine their relative importance and usefulness in policy-oriented studies of shore protection and in their assessment of tradeoffs among the policy options to determine whether or not all economic techniques provide similar policy recommendations (there is a possibility that different policy outcomes could result from different techniques because the techniques emphasize different criteria and information);

the building of pertinent databases, which involves the collection and development of appropriate data necessary to specific economic approaches will be dependent on the specific approach and can be a very lengthy process. Some of these data can be gathered from the respective ACOE districts (especially for inventory surveys of physical structures), some will involve statistics and data generated from the state government;

future studies with research designs to isolate and identify economic activity dependent on the coastal zone and/or on specific beach nourishment projects. Such studies may require data on economic activity and tourism expenditures that are location-specific, in terms of the relative proximity to the shoreline, and to beach nourishment projects, and be collected on a seasonal basis;

resources recommended for support of economic studies are estimated to be in the $100,000 to $150,000 range depending on the 1) time frame, 2) economic method, 3) range and detail of alternative policy options to be assessed, 4) treatment of risk and uncertainty, and 5) level of detail required of the data. However, such an estimate could quickly become a lower bound range involving a team approach of economists and expenses of $75,000 - $100,000/year for several years;

the ICF (1989) study is an exercise that demonstrated the complexity of the issues involved in public policy tradeoffs. However, this is the tip of the iceberg; an analysis should be intertemporal rather than static; performing an analysis that is intertemporal and involves many cost and benefit components is an extremely tedious and complex task; resources of time and funding must match the complexity of the problem;

the analysis must incorporate the elements and effects of uncertainty in benefit and cost estimates since these depend on the probability of storm occurrence as well as the magnitude of the storm; hence cost and benefit items are stochastic in nature and vary according to storm severity, time, and sea-level rise, with sea-level rise magnifying the risk elements and the effects of erosion and storm damage;

the analysis must also incorporate the element of risk associated with project failure and outcome; and

the ICF (1989) demonstrated that there are many more elements to consider regarding policy tradeoffs (level of development, future vs. existing development, level of erosion, storm-events, availability of flood insurance, who should bear the burden of flood insurance and that of cleanup and repair costs, land rezoning issues, reconstruction policies, and future shore protection policy stances); future analysis must be designed to incorporate these numerous and varied elements.

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Chapter 1 - Introduction

Background

Coastlines have been described as fragile ecosystems that are susceptible to continual erosion processes from natural forces, e.g., tides, currents, storms. If left unabetted the natural process of coastal erosion will change the natural configuration of coastlines (e.g., peninsulas, barrier islands) through a process of attrition similar in nature to a continually depreciating resource/asset. If nothing is done to slow or maintain the erosion rate, the asset physically decreases over time, similar to a storage technology with depreciation. In the case of a coastline, the physical characteristic of this boundary changes over time (i.e., spatial dimensions), decreasing in some areas and increasing in others.

Prior to man's development of these coastal areas, the natural process of erosion posed relatively little problem. There was little economic development to warrant public protection and intervention a century ago compared to modern times. Presently, where the coastal zone is undeveloped the process of erosion creates few problems other than the shoaling of tidal inlets and navigable waterways. But, where widespread and extensive economic development has occurred involving both public and private investment, a new and continual problem has emerged. The issue of shoreline protection is to slow the natural process of attrition (decay), and to minimize the physical and economic damage that can occur to shorelines, as well as to physical structures and to infrastructure (i.e., roadways, sewer lines, utility lines, etc) in close proximity to the shoreline. Over time, oceanfront real estate has become closer to the water and is threatened from storm surges. Private individuals and small communities, in turn, demand protection and assistance from government authorities for a location and investment decision that has become susceptible to the natural process of coastal erosion and storm-events. Had such problems been foreseen and had zoning and federally-subsidized flood insurance (through the National Flood Insurance Program, NFIP) been designed to discourage economic development, the problem of coastal protection might have been avoided or lessened and, in turn, either minimized or eliminated a now necessary public service (ICF 1989, noted that the NFIP had important consequences on development, i.e., in its promotion). However, over time, given society's preferences and patterns of location and development, this problem was probably inevitable. Furthermore, the occurrence of sea-level rise will continue to subject different areas of land to the threat of coastal erosion and storm damage.

Detrimental effects on specific economic activities occur as a result of physical damage or loss of shoreline and property structures in close proximity to the shoreline, from both long-term erosion and short-term erosion associated with storm-events. Many of these effects can be classified as supply effects; i.e., changes that reduce the abundance (number, quantity, or spatial dimensions (length, width)) of beachfront property, beaches, and the coast in general. Effects on the demand for locations in close proximity to the shoreline (i.e., physical property), and on activities involving such locations (e.g., recreational beach use, birding, fishing, etc.) can also occur due to repeated and one-time physical damage and shoreline loss. However, detrimental effects seem to have a perverse effect on such demand behavior, in that demand has usually increased over time no matter what the detrimental effect or loss is. Property values have usually risen over time the closer properties are to the shoreline.

Regarding coastal tourism, precise estimates of New Jersey's coastal tourism industry are unavailable. Estimates developed by Longwoods Int'l. can give some idea of the range of its magnitude. For the Barrier Island component, an estimated average over the three-year period 1992-94 was $787.9 million a year ($786.88 million/year without gambling expenses) in 1992 dollars. However, this estimate only represents one component of beach travel and tourism activity (i.e., that portion of tourists that rented accommodations along the Jersey Shore), and underestimates the importance and magnitude of tourism expenditure activity in the coastal region of New Jersey (other components of beach travel consist of other overnight trips <u>and</u> day trips). On the basis of the estimated number of trips and the estimated average trip expense, an upper bound estimate of the three-year average (1992-94) expenditure of all beach related travel was estimated at $1,887.64 million a year ($1,726.75 million/year without gambling expenses). However, the reader is cautioned in reading too much into these estimates; they were developed for illustrative purposes. Little confidence can be placed in the estimates; such estimates should be developed from a single sample base rather than from two, and should be developed as part of an objective of the travel and tourism studies in the form of a range. The estimates developed are meant to illustrate the point that projected tourism expenses associated with beach trips based on the Barrier Island component are underestimates of such activity, while the county-level estimates of the four coastal counties are overestimates.

New Jersey's coastal tourism industry depends closely on the actual and perceived condition of the shoreline both in terms of the effects of erosion and the effects of marine pollution. For example, Ofiara and Brown (1989), using the number of beach tags sold as a proxy for beach attendance, found a decrease in beach tag sales at public beaches in New Jersey that ranged from 7.9% to 34% from 1988 marine pollution events. Both processes of coastal erosion and marine pollution, in turn, can adversely effect the state's coastal economic activity. Ofiara and Brown (1989) estimated direct economic losses from the 1988 marine pollution events that ranged from $820.7 million to $3,060.8 million to the State of New Jersey. Thus, any protection of the shoreline and water quality, in turn, will maintain the economic return of the state's coastal tourism industry. One can think of this physical asset, the coastal zone as generating economic returns in terms of jobs, income, sales, and tax revenues. Any decrease or lessening of this coastal area could adversely affect travel and tourism to the area (direct effects) and in turn, economic returns (indirect effects).

Economic analyses of policies concerning the management of coastal erosion can become increasingly complex given real world scenarios. Shore protection is complicated due to risk associated with the expected life of a project which can vary across projects, as well as, expected returns associated with each project that, too, can vary across projects. Furthermore, coastal shorelines, and hence, shore protection projects are also subject to exogenous risk due to such factors as the geographic location, physical characteristics of the shoreline, weather patterns, and storm activity and intensity, where over a sufficiently long time period episodes can be identified and categorized that range from periods/occurrences of high risk (i.e., high storm activity) to periods of low risk (low storm activity), and from sea-level rise. As one might expect, a project undertaken during periods of low risk would have the longest expected life (defined as the difference between the projected life measured in years and the actual time a new project must be implemented for the same coastal location), and greatest economic return compared to initiating the same project during a period of high risk. However, shore protection must be in place before periods of high risk are expected to occur just to maintain the coastal area; these projects could be treated as one-time emergency projects only to last the life of the current storm activity. The effect of sea-level rise could magnify both the above risk factors, and the effects of erosion and storm damage.

Ideally, one would like to conduct a welfare analysis (i.e., a first-best analysis) of alternative policy options of shore protection based on benefit data (i.e., measures of the values of society's welfare associated with different policies), but such an approach becomes untractable. These data are not readily available, and concerning recreational use and nonuse values, costly field surveys are necessary and sometimes involve highly controversial economic techniques. Furthermore, aggregation problems exist that involve many individuals with different tastes so that determining some type of benefit function that would depend on the utility of these individuals given alternative policy options becomes highly complex.

In the absence of a first-best approach, the most common technique used in economic analyses of shore protection policies is Cost-Benefit Analysis (CBA), a second-best approach, for a variety of reasons. Using such an approach, the investigator can determine the ranking of each project in a particular year with the decision-rule to fund those projects that yield the greatest net economic benefits/returns until the program funds are exhausted (a similar criteria was used in the 1981 New Jersey Shore Protection Master Plan). This process could be repeated each year. However, CBA has several limitations that may prove unrealistic. Some limitations of CBA are that it assumes that benefits are measurable and can be accurately measured, which for nonmarket goods such as beach use, benefits usually are not explicitly measurable and are subject to measurement error. Comparisons can only be made across projects that yield equal net benefits, and CBA is further limited due to its association with welfare or pareto criteria; projects which yield a pareto improvement will be unanimously superior to all other projects, but one can say little about any two projects which yield the same social welfare without further assumptions about distributional aspects of the projects to members of society (i.e., assumptions regarding equity across society). Furthermore, the treatment of risk and uncertainty creates additional complications for CBA (detailed discussion is contained in Chapter 2.) However, in spite of its shortcomings, and in lieu of perhaps "better" approaches, CBA is widely used and provides practical decision rules for public officials that face public policy decisions.

Objectives

The purpose of this report is to address and examine both the economic issues and the economic theory relating to the management of coastal erosion, from the dual perspective of coastal erosion processes and the public provision of shore protection. It is meant to explore the issues involved in shore protection decision-making that must be considered in the preparation of a new Coastal Hazard Management Plan. In this regard, this report also summarizes characteristics of typical beach fill projects in New Jersey during the 1960-94 period from which economic analyses could be performed.

Specific objectives are to: 1) examine the economic theory and economic techniques that can aid in understanding and evaluating shore protection policy and coastal erosion issues; 2) provide a review and assessment of shore protection efforts over the 1960-94 period; 3) review all pertinent literature concerning economics and shore protection, recreational beach use and benefits of shore protection, coastal tourism, the New Jersey Shore Protection Master Plan (NJSPMP) pertaining to its economic analysis, U.S. Army Corps of Engineers (ACOE) studies, and any relevant policy evaluations of shore protection; 4) summarize characteristics of typical beach fill projects in New Jersey during the 1960-94 period from which economic analyses could be performed; and 5) provide future directions and recommendations.

The plan of this report is as follows. The pertinent economic theory and techniques are contained in Chapter 2. Chapter 2 is meant is to serve as a self-contained primer on economic principles and guidelines, and Cost-Benefit Analysis (CBA) useful in evaluating shore protection policy and coastal erosion issues. A technical appendix contains an overview of three decades of shore protection efforts in New Jersey (1960-94). It is meant to form a base from which economic analyses could be performed. The last chapter, Chapter 3, contains a detailed review of the economic literature relating to the economic value of beach use and beach protection, coastal tourism, and public policy issues of shore protection. The economic component of the NJSPMP is reviewed here, as are ACOE studies and policy oriented studies of shore protection. In addition, characteristics of typical beach fill projects in New Jersey over the 1960-94 period are summarized in Chapter 3. A contribution of this report is the discussion of appropriate economic issues, theory, and methods useful in examining the joint issues of shore protection and managing coastal erosion, and of current economic studies and analyses of beach use and shore protection. Such material was lacking in the NJSPMP. A detailed and thorough analysis of alternative policy options must be deferred to future efforts.

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Background

Throughout this chapter several terms and concepts will be used to describe detrimental economic effects and associated measures of lost economic value attributable to coastal erosion, as well as beneficial economic effects and associated measures of gains in economic value attributable to shore protection efforts. Such a discussion will give the reader perspective in understanding and identifying benefits and losses that can result from shore protection and coastal erosion, respectively.

Some discussion of terminology will be useful. Economic losses can be thought of as losses in economic activity (e.g., sales, output, employment, income, etc.) from coastal erosion and storm damage. Losses can also represent lost economic value from erosion and storm damage. Economic losses and lost economic value represent different concepts. Benefits and economic benefits suffer from the same problem; they have different meaning and usage in various contexts. There is a strict meaning of economic benefits from economic welfare theory: gains in economic value associated with changes in economic welfare measures. This measure will be referred to as economic value (or economic welfare) in this report. In the context of economic impact analysis, benefits can also be considered as gains in economic activity. And in a CBA context, benefits have another meaning and usage; benefits represent all gains in economic value and in economic activity from a proposed project.

Economic Measures

A number of different economic measures exist that are conceptually separate. From a national income accounting perspective, measures of economic activity represent total expenditures of final goods and services categorized by distinct sectors, i.e., GDP (Gross Domestic Product) measures. The literature of input-output analysis and economic impact analysis treats economic measures as the dollar amount of output (sales), number of individuals (employment), the dollar amount of income (income), and the dollar amount of tax revenue (taxes) that result from an outside change . This represents dollar measures of sales, income, taxes, and employment). From economic welfare theory, economic benefits and economic losses are other types of economic measures that represent gains or losses in economic value. Lastly, from the CBA literature, economic benefits and economic losses are measures that represent gains or losses in economic value and in economic activity (increases/losses of sales, income, employment). Each of these concepts will be treated in turn.

Aggregate Economic Activity

Aggregate economic activity measures are usually referred to as GDP (Gross Domestic Product) or GNP (Gross National Product). These measures represent the total value of all final goods and services produced in an economy for a given time period, usually a year. The distinction between GDP and GNP is due to the definition and location of business entities, i.e., firms. If one is concerned with all sales within the boundaries of a country or region, GDP is the relevant measure (e.g., Coca Cola sold in the US). But if we are concerned with sales of all goods and services produced by domestic-owned firms or firms owned within a region, that is, sales both inside and outside of the country, then GNP is the relevant measure (e.g., sales of Coca Cola in the US and sales outside the US). Because prices can change over time, the above measures need to be adjusted to yield real GDP (gdp), real GNP (gnp), which represent the value of all final goods and services produced in an economy in terms of constant dollars. As such, changes in gdp/gnp will now reflect changes in real output.

GDP (GNP) can be measured by two basic approaches, the flow of expenditures approach and the flow of earnings approach, because economic activity can be represented as a circular flow. This means that final goods and services are produced by firms using inputs (labor, capital, land, entrepreneurial skill) usually provided by households. These inputs are, in turn, paid compensation (wages, rent, and profits, respectively) which constitute the income that is used to finance spending on goods and services. As a result, the sum of spending will equal the sum of compensation, by definition. Basically, the flow of expenditures approach defines GDP as the amount of spending on: consumption (C), private business investment (I), government services - both federal, and state and local (G), and if there is foreign trade, exports (X) less imports (M). Hence, $GDP = C + I + G + X - M$. The flow of earnings approach takes the sum of compensation paid to all inputs: wages (for labor), rent (for capital and land), and profits (for entrepreneurial skill) as national income. Given several adjustments (these include depreciation, and indirect business taxes) this measure will now equal spending on goods and services.

Economic Impacts

Economic impacts represent another and different measure of economic activity. Impacts measure the amount of aggregate economic activity usually in terms of sales ($'s), income ($'s), employment (No.'s), and sometimes tax revenues ($'s) that are associated with a change in the economy (e.g., structural change - plant closings, reduced demand, increased demand) or policy change (e.g., proposed regulation). Many times they are based on multipliers that not only account for direct effects (direct expenditures on goods and services), but also indirect and induced effects. Economic impact measures will then reflect the effect that changes (structural changes, such as changes in output, investment, employment; or proposed policy changes) in a particular sector (e.g., services sector from expanded gambling facilities) have on the sales (or employment, etc.) of other sectors within a study economy. Economic losses (or damages) caused by storms and erosion, as well as economic gains from shore protection can also lead to economic impacts. Here, impacts represent the monetary loss or gain to a particular segment of the economy. This effect consists of several rounds of impacts, that can be described as a multiplier effect. The first round of impacts involves only the sector of interest (i.e., primary sector) and sectors that directly interact with the primary sector (i.e., secondary sectors). Subsequent rounds involve impacts based on the interaction of these secondary sectors with still other sectors (tertiary sectors) i.e., re-spending activity, and then the interaction of these other sectors with still other sectors, until the effect originating in the designated primary sector is transmitted throughout the economy in question.

Note that the above economic impact measures differ from those of aggregate measures such as GDP. The latter measures net changes in the value of final activity without double-counting. Economic impact measures do contain some double-counting in the summation of the effects throughout the economy which are precipitated by an initial change. To give some appreciation for this, take for example a measure of impacts referred to as primary economic impacts. This is calculated as the sum of sales of output <u>and</u> expenses for inputs for a given industry or sector. First, this measure is a measure of ***partial*** economic activity generated by the study sector rather than one of ***total*** economic activity. This is because it considers only the <u>direct</u> economic activity generated from the effect of the primary sector on secondary sectors, and not the effects of interactions among secondary sectors with still other sectors in the economy; that is, multiplier effects are not included. Secondly, the measure includes double-counting compared to aggregate accounting measures as GDP. Here, expenses for inputs of the primary sector reflect sales of outputs of the secondary sector (the secondary sector can be considered as producing intermediate goods). From a national accounting perspective, by including the full value of input expenses <u>and</u> output sales rather than just input expenses and the value added (from further processing by the primary sector) as is done in GDP measures we have double-counted by some degree, and have overstated the true measure of economic activity throughout the production process. This error is compounded when the effects of multipliers are considered. An arithmetic example will provide further illustration. Consider the production of a cigar. Here the first stage consists of a farmer selling tobacco to a cigar maker for $3. The value-added to the farmer is $3 which covers his costs of production (returns to labor, land, capital, and entrepreneurial ability). The second stage in the process consists of the cigar maker. Here he manufactures and sells cigars to a cigar store for $8. Now the value-added at the second stage is $5 ($8-$3, i.e., sales less expenses). In the final stage, the cigar store sells these cigars to consumers for $15; the value-added is now $7 ($15-$8). The measure of GDP in this example would be the sum of the value-added at each stage, $15.

(Note this is equal to the value of final sales.) But by summing sales and expenses at each stage of production ($3 + $8 + $15) we have double-counted the true measure of economic activity; GDP is $15 and not $26. In this simple example, the measure of primary economic impacts overstates the true measure of economic activity by a factor of 1.7333 times, excluding multiplier effects. This example also illustrates the problem of basing arguments for shore protection solely on expenditure impacts from beach or coastal tourism; these impact measures can grossly overstate the true measure of economic activity in shore regions. Without evidence of the magnitude of the error involved, expenditure impacts must be treated with caution and not as fact.

Benefits as Measures of Economic Value

Specific measures of changes in economic welfare are quite theoretical concepts and are covered in more detail in various textbooks (see Just et al. 1982, Freeman 1979, 1993, Dinwiddy and Teal 1996, Johansson 1991). These measures are associated with losses and/or gains in economic welfare and represent lost economic value and/or gains in economic value, respectively. In the production sector, the measure of lost (gains in) economic value is economic rents (or simply rents), i.e., the reduction (gains) in profits plus producer surplus. Producer surplus is included because it represents a monetary surplus that accrues to the producer (the firm, entrepreneur) over and above the value of goods and services provided (i.e., over variable costs of production), and is a more appropriate measure of producer welfare than profits alone (Just et al. 1982). Producer surplus can be regarded as a measure of the net economic value to the producer from the production and sale of goods and services.

In the consumption sector, a measure of lost (gains in) economic value is the reduction (gain) in consumer surplus, a monetary surplus that accrues to the consumer over and above expenditures from consumption of a good (Just et al. 1982). It represents a net economic value to the consumer that accrues to consumers from consumption activities. Any reduction (gain) in it can be considered a loss (gain) in economic value. At this point it should stressed that the measure of consumer surplus is not very accurate, especially if income effects are present; then more specific consumer welfare measures are appropriate (Just et al. 1982, Freeman 1979, 1993, Auerbach 1985).

In practice, coastal erosion and shore protection can affect many consumers and producers, and economic welfare analysis of the changes at the individual level are both impractical and burdensome. To be useful to public officials, economic welfare analysis requires aggregation over the individual economic units (consumers and producers) that are affected. This can be accomplished by analyzing the change in economic welfare at the market level since the aggregation process yields the economic surpluses associated with the market, or total, demand and supply of private goods and services. These are equivalent to the sum of economic surpluses over all consumers and producers in the market under competitive conditions (Just et al. 1982). Hence, the change in aggregate welfare will reflect the sum of changes in individual welfare under competitive conditions.

Unlike private goods and services, public goods and services such as shore protection are usually provided at zero or nominal costs and are not rationed by price. Because one does not observe market prices and quantities of public goods, changes in economic welfare resulting from changes in levels of the public good must be determined at the individual user level and then aggregated over all users. This involves the use of various nonmarket valuation and/or indirect market valuation techniques based on representative samples of individuals to obtain estimates of economic welfare associated with the good in question (these techniques are treated in the textbooks previously referenced).

In order to evaluate changes in economic welfare that result from coastal erosion and storm-damage, and from shore protection, two situations in either case must be compared -- the economic welfare of the economy that results with the presence of coastal erosion (shore protection), and the economic welfare of the economy that would occur without it (i.e., in the absence of coastal erosion (shore protection)). The net change would represent the change in economic welfare attributable to coastal erosion (shore protection). A procedure known as the "with and without" rule commonly used in Cost-Benefit Analysis can assist in this process and avoids attributing effects to an event which are not caused by it.

In the process of assessing changes in economic welfare that result from coastal erosion and storm-damage, and from shore protection, the measures of economic welfare can further be identified as being national or regional in scope. The approach that the U.S. Army Corps of Engineers (ACOE) bases their analyses and decision-making on is based on National Economic Development (NED) criteria. Regional development (RD) losses (or gains) are the lost (or gains in) economic value(s) that result from erosion/storm-damage (shore protection) in one geographical area (where the gains in one area are equal in size to the values lost in another area). NED losses (or gains) represent lost economic values that occur as the result of erosion/storm-damage (shore protection) in one geographic area but do not reappear as gains in other geographic areas. These two definitions classify losses (or gains) at two extremes; losses (gains) in one area that are offset by equal gains (losses) in another area -- RD losses (gains), and losses (gains) in one area that do not accrue as gains (losses) in another area -- NED losses (gains). And situations can exist where both types of effects occur.

Benefits in Cost-Benefit Analysis

Benefits in CBA are used in a different context compared to that of welfare economics and, thus, represent different measures. In CBA, benefits refer to all gains in economic value (welfare component) and gains in economic activity (such as increases in sales, income, employment) that directly and indirectly result from a proposed project. Cost-savings are also sometimes included in CBA benefit measures. Therefore, benefits in the context of CBA can comprise measures of economic value and economic impact benefit measures. However, a word of caution. Care must be used to avoid any double-counting of benefits. As an example, consider the aggregate flow of capital that has left an economic sector due to an outside (exogenous) effect, such as the loss or damage to real property and physical structures from erosion/storm-damage. It is equal to the sum of reduced revenue plus increased costs in the production sector, or the sum of consumer surplus lost and reduced expenses in the consumption sector. When both sectors are included, it is equal to the sum of reduced revenues and increased costs from the production sector plus the reduction in consumer surplus from the consumption sector. Consumer expenditures are not included, because they represent purchases of goods and show up in the production sector as revenues. Including both consumer expenditures and producer revenues would be double-counting.

Economic Methods

Present Value Analysis

Present value analysis is the technique that economists use to compare costs and/or benefits of various projects over time to choose among projects given limited budgets and select a "best" or several "bests." Discussion of background material will prove useful so that everyone will be on an equal level. First, there are two variations of the present value analysis commonly used by economists, cost-effectiveness analysis and cost-benefit analysis, that are often confused. Cost-effectiveness analysis concerns the minimum cost way to achieve a given objective. Cost-benefit analysis (CBA), however, considers both the benefits and costs associated with a particular project. More detailed explanations of these two versions are discussed below.

Secondly, there are slightly different interpretations of the present value analysis in the fields of economics and in finance. In economic theory, CBA is a technique to use to evaluate the economic feasibility of public projects, i.e., projects financed with public funds (Kohli 1993, Bohm 1973). CBA is also referred to as capital budgeting, financial analysis or investment analysis in finance theory and is used to evaluate decisions such as plant expansions and new product development; it will be referred to as financial analysis in the remainder of this report (Brealey and Myers 1991). The main difference between CBA in economic theory and financial analysis in finance theory is due to the treatment and measurement of benefits that accrue to the project and the decision criteria. In financial analysis, benefits are treated as all additional income (i.e., sales revenues) that results from the project. The criteria of financial analysis is to undertake a project if the internal rate of return on total investment based on current market prices for a proposed project is greater than the prevailing market interest rate. Regarding CBA, benefits are based on the extra economic surplus (in all economic sectors affected by the project) that are attributable to a project. The criteria in CBA are to undertake a project if the present value of net benefits (benefits less project costs, discounted) exceeds zero, or equivalently, if the ratio of the present value of benefits to the present value of costs exceeds one. In sum, financial analysis considers direct effects of a project, that is, direct benefits measured as additional income from a project. CBA is based on all direct and indirect effects attributable to a project, all direct and indirect benefits measured as gains in economic surplus due to a project. Furthermore, financial analysis is not an appropriate technique nor decision criteria for public projects because government bodies are not in the business of maximizing profits. Because public projects involve the use of public funds, an objective such as to maximize social welfare (i.e., the welfare of society) is a more appropriate decision criteria.

All investment decisions and the choice among various projects involve a time element in most cases and a concern among economists is to properly evaluate present and future dollars. The issue is that price levels change over time due to inflation and, because one can earn the market rate of return on investments, one must use a common measure to equate present and future dollars. This is usually accomplished through the mechanism of discounting, to express all dollars as present dollars (commonly referred to as the present value) (in much the same manner one could express all dollars in terms of future dollars).

The basic present value (PV) formula for CBA is:

(1) $PV = -C_0 + (B-C)_1/(1+r) + (B-C)_2/(1+r)^2 + \cdots + (B-C)_n/(1+r)^n$, or

(2) $PV = -C_0 + \sum (B-C)_i/(1+r)^i$,

where "$-C_0$" refers to the initial cost outlay, B the benefit in each period, C the cost in each period, r the discount rate, and n the time period (Herfindahl and Kneese 1974, Kohli 1993). These formulas are appropriate for projects that realize costs and benefits over a time period. The manner in which the formulas are written with the first element " $-C_0$" represents a situation where a project involves front end investment (such as when a municipality buys dredging equipment to renourish their beaches). In some cases, there is no front end investment and then the term "$-C_0$" is simply dropped (such as when a municipality would hire a contractor to provide shore protection). The present value of net benefits (benefits less costs, discounted) is the appropriate measure for comparing projects over time given equal scale (i.e., size) and time period.

Cost-Effectiveness Analysis. Cost-Effectiveness Analysis concerns the minimum cost method to achieve a given objective. By definition, it ignores benefits and, thus, does not address economic rationale to achieve a given objective. It is appropriate when considering how a project can be implemented in the least expensive way. The procedure is to estimate all costs for a particular option over time, discount these costs, and then sum the discounted costs (discounted costs represent the total cost in today's dollars); the sum of discounted costs is referred to as present value of costs. Equation (2) can be easily modified as:

(3) $PV = -C_0 + \sum (C)_i/(1+r)^i$,

The decision criterion is to select that project with the smallest present value of costs over time. This formula can also be used in comparing projects when the benefits realized from alternative projects are equal, and hence one only needs to consider comparative costs since the only concern is to provide a project in the cheapest way possible.

Cost-Benefit Analysis. Cost-Benefit Analysis (CBA) is the primary method in which both the benefits and costs associated with a project are considered. It is based on economic justifications in determining the implementation of a project; that is, whether the outcome of a project is worth the costs of achieving it. Here the analyst must identify, quantify, and value all possible benefits and costs associated with the presence of the project as opposed to a situation without the project, choose a time horizon and discount rate, and face an investment constraint. This technique has two variations commonly used. One is to examine the difference among benefits and costs (benefits less costs) for each time period, discount it, and then sum it, giving the present value of net benefits over time, i.e., Equation (2). The decision criterion is to select that project that yields the maximum present value of net benefits over time. The second version is the B/C ratio, where the discounted sum of benefits is divided by the sum of discounted costs:

(4) $$\text{B/C ratio} = \frac{\sum (B)_i/(1+r)^i}{\sum (C)_i/(1+r)^i},$$

When benefits equal costs this ratio will equal 1, hence if this ratio is greater than 1 benefits will be above costs. The decision criterion is to select that project that yields the maximum B/C ratio. The use of this ratio is quite controversial among economists. A brief summary will suffice. Most agree that selection of a project should not be based solely on the B/C ratio, it should be used in conjunction with discounted net benefits to rank alternative projects (Margolis 1959, Herfindahl and Kneese 1974). Also most agree that maximizing the B/C ratio in order to select a project is inappropriate (Herfindahl and Kneese 1974, Eckstein 1958). Where most economists would discourage the use of the B/C ratio concerns aggregate (i.e., total) benefit-cost comparison of projects, conversely most agree that the B/C ratio is useful in examining incremental (i.e., an extra unit, marginal) benefits and costs associated with a project in each period (Herfindahl and Kneese 1974, Eckstein 1958). The association between *total* benefits and costs with *marginal* benefits and costs in project choice will lend perspective on these points. Recall the decision criteria for

CBA based on net benefits, choose that project with a maximum of discounted net benefits. Maximization of discounted net benefits (total benefits less total costs) occurs where discounted marginal benefits (MB) equal discounted marginal costs (MC) or where the ratio of discounted MB to discounted MC is equal to 1. Hence, a B/C ratio not equal to one implies a situation where discounted net benefits are not at a maximum.

Further complications arise when comparing projects of unequal scale and time frame. The following points apply because the decision criterion for both CBA and cost-effectiveness analysis changes. The B/C ratio, Eq. (4), is useful in comparing alternative projects of unequal scale only when no extreme variation in scale (referred to as capital intensity) is present (Eckstein 1958). In a sense the B/C ratio reduces the scale factor; consider two projects one twice the size of the other so that all proportions are equal, then the ratios will be the same. But, this raises another issue concerning the use of capital investment in a project, i.e., front end investment versus rationing of capital investment among various periods through the project's life similar to annual operating expenses. Then the criterion and comparison become more complicated (see Eckstein 1958 for more detail). When faced with unequal time frames in comparing projects, the time frames should be made compatible. This can be accomplished by using a least common denominator (LCD) to determine equivalent time periods (e.g., a 3 year and a 5 year project have a LCD of 15 years). And finally, the literature is rich with discussion of the appropriate discount rate to use (see Herfindahl and Kneese 1974, Bohm 1976, Mishan 1976, Kohli 1994).

Economic Impact Analysis (Public Policy Analysis)

Economic Impact Analysis (EIA) also needs clarification. Many applied policy problems and proposed federal regulations use variations of EIA commonly referred to as Public Policy Analysis (Weimer and Vining 1991). Here the analyst conducts an economic analysis to determine the effects (impacts) of proposed policy changes on all appropriate economic units (consumers, producers) and/or economic sectors (consumption, production, government), where the economic effects associated with the policy are identified and quantified. Such an approach will be referred to as a Public Policy Analysis in the remainder of this report. Furthermore, the meaning of economic impacts and of economic impact analysis based on this technique is different and must not be confused with similar terminology used in the context of an input-output analysis discussed below.

Input-Output Analysis

Economic Input-Output Analysis (I-O) is a specific technique developed by an economist (Leontieff 1966) and is based on an input-output model of aggregate measures of economic activity such as sales revenues, income, and employment related to an economy defined by geographic-political boundaries (state, region, nation). A main feature of this technique is to determine "multipliers" which can be thought of as how changes in primary economic activity translates into final economic activity, and to examine how changes in specific sectors (manufacturing, services) of an economy affect the entire economy in question. When one examines such changes throughout the economy based on an I-O model, such an analysis is referred to as an economic impact analysis. I-O analysis was primarily developed to address policy questions such as what are the effects on sales, income, and employment of various structural changes in the economy (e.g., plant closings/openings, changes in local infrastructure investment, reduced demand), and of proposed policies (e.g., different minimum wage policies, proposed regulations).

The following discussion will give some intuition behind the I-O approach. The basic premise is that each dollar of expenditures and/or sales in an industry or sector has an effect on other industries and sectors as well as on regional (or state and national--whatever the study area is defined as) output, income and employment. Any change in economic activity (e.g., sales, investment, employment, technology) will produce a change in a multiplier (or sequential) fashion throughout the study economy. The magnitude of impacts within an economy resulting from a change in part of the economy is influenced by the degree of interdependency that exists among the various sectors within that economy. These I-O models can be solved for sector outputs (i.e., sales), income, employment, and tax revenues in some cases. Based on an I-O model solved for sales, the economic impacts that correspond to the level of activity in a final demand sector on the level of outputs of the other sectors and on the economy as a whole can be estimated. These impacts in turn are characterized as either direct, indirect, or induced effects. (Similar remarks can be developed for I-O models solved for income, and employment). ***Direct*** effects represent the change in demand of industries or sectors directly affected from a change in the final demand of a given primary sector. Suppose an increase in demand for certain recreational activities such as marine fishing and boating, or even gambling in Atlantic City occurs in a local economy (say Atlantic County). This will result in an increased supply of fishing equipment and trips, boats, and expanded gambling facilities to meet the demand represented by increased sales. This, in turn, will increase the suppliers' purchases of inputs (goods and services) used in the manufacture of fishing equipment, recreational boats, and of gambling equipment. Here, an increase in the demand for recreational activities has resulted in a ***direct*** effect on those industries and sectors (secondary sector) that supply the primary recreational sector.

Indirect effects measure the effect of secondary sectors' increased purchases of the inputs necessary to meet the increased demand for their products. The effect of income generated from this increased activity that is recipient in the study economy is defined as an ***induced*** effect.

Aggregate economic impacts on a given economy are referred to as multiplier effects that can measure output, income, and employment (and sometimes tax revenue) effects. ***Output*** multipliers measure the total change in the economic activity associated with output (sales) of all sectors of the economy (primary, secondary sectors and beyond) that is generated from an additional dollar of final demand (goods and services of the primary sector). The total change in income that occurs in a given economy due to a dollar change in final demand is reflected by the ***income*** multiplier. ***Employment*** multipliers, have a slightly different interpretation because they are not in terms of dollars. They show the change in a given economy's employment generated by a change in output that causes an employment change of one unit.

Two types of multipliers are estimated in I-O studies to project the total economic impacts created from a change in final demand (sales) per dollar of direct change in the primary sector within the economy (i.e., endogenous primary sector). ***Type I*** multipliers are defined as (D+I)/D where D=direct and I= indirect effects, and represent the combined direct and indirect effects of economic activity within a given economy per dollar of direct change in the designated primary sector. ***Type II*** multipliers, (D+I+IN)/D where D and I are already defined, and IN=induced effects, measure the combined direct, indirect <u>and</u> induced effects of economic activity throughout the economy per dollar change in the primary sector within the economy. It is the product of these multipliers with sales (for output and income effects), and employment in the primary sector (for employment effects) that results in projections of economic impacts.

This is how the impacts of tourism expenditures on the state on New Jersey are derived in the Longwoods reports (Longwoods Int'l. 1992, 1994, 1995) of the economic impact on the New Jersey travel and tourism industry. But measures of economic activity based on such economic impacts involve double-counting as previously discussed, and have overstated the true measure of aggregate economic activity as represented by GDP. This error is compounded when the effects of multipliers are considered. This point cannot be overemphasized. Furthermore, this illustrates the essential weakness and problem with arguments for shore protection based solely on expenditure impacts from beach or coastal tourism; these impact measures can grossly overstate the true measure of economic activity in shore regions. Without evidence of the magnitude of the error involved, expenditure impacts must be treated with caution and not as fact. Estimates of direct expenditures is preferred compared to expenditure impacts of tourism (the Longwoods reports develops both estimates).

Simulation Models

Simulation models are hypothetical computer models written in either primary computer code or in a simulation language to represent (mimic) an actual situation and to then simulate the specific application and changes to it (see Murray 1993 for more details). They have been used in epidemiology to simulate the spread of an actual disease epidemic. It has been used in population ecology to simulate population dynamics and the actual spread of an insect population outbreak and the effects of different control strategies. And some applications have been based on bio-economic models of fisheries.

Risk-Return Decision Models

Risk-Return models are from the field of finance and consist of the applications of portfolio theory, mean-variance models, and variations of the capital asset pricing model (see Brealey and Myers 1991 for the basics). They are used to decide among tradeoffs between risk and return so as to determine an efficient portfolio of holdings (least risky collection of assets that yield the greatest return) for various risk levels. These models are highly complex and indispensable to analysts and researchers in financial markets.

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Chapter 3 - Economic Aspects of Shore Protection

Introduction

This chapter contains a detailed review of the economic literature relating to shore protection, beach use, coastal tourism, and public policy issues. The economic component of the New Jersey Shore Protection Master Plan (NJSPMP) is reviewed here, as are ACOE studies and policy-oriented studies of shore protection. In addition, characteristics of typical beach fill projects in New Jersey over the 1960-94 period are summarized in this chapter.

Specific objectives are to: 1) review all pertinent literature concerning economics and shore protection, recreational beach use and benefits of shore protection, coastal tourism, the New Jersey Shore Protection Master Plan pertaining to its economic analysis, U.S. Army Corps of Engineers (ACOE) studies, and any relevant policy evaluations of shore protection; 2) summarize characteristics of typical beach fill projects in New Jersey during the 1960-94 period from which economic analyses could be performed; and 3) provide future directions and recommendations.

The overall purpose of this report is exploratory rather than conclusive. It is meant to examine the issues involved in shore protection decision-making that must be considered in the preparation of a new Coastal Hazard Management Plan.

The economic literature reviewed in this chapter is in three main areas: 1) studies of the economic value of beach use and beach protection, 2) studies of the impacts of coastal travel and tourism , 3) previous ACOE studies, and 4) policy-oriented studies of shore protection including a review of the NJSPMP. Following the literature review is a brief section about characteristics of typical beach fill projects completed in New Jersey over the 1960-94 period. Recommendations for further work concludes the chapter.

Literature Review

Economic Value of Beach Use and Shore Protection

Curtis and Shows (1982, 1984). One of the first studies to assess the economic value of recreational beach use, (Curtis and Shows 1982, 1984) conducted two investigations based on surveys in Florida. In 1981 a survey of residents and tourists were conducted by face-to-face interviews (Curtis and Shows 1982). A Contingent Valuation (CV) method based on an open-ended question format was used to elicit the willingness-to-pay (WTP) of residents and tourists for beach use at Delray Beach, Florida. Survey results indicated that residents were willing to pay

$1.88/person per day for beach use, while tourists were willing to pay $2.15/person per day in 1981 (Table 1). Specific details of the study were not readily available -- these studies were summarized in Bell and Leeworthy (1986); it is not known what type of sample design was used nor if specific questions about the value of beach protection were included.

In 1983, Curtis and Shows (1984) appeared to have conducted a similar study of the value of beach use at Jacksonville Beach, Florida. Residents and tourists were surveyed in 1984 and results indicated that residents were willing to pay $4.44/person per day and tourists $4.88/person per day for beach use (Table 1). Again, specific details of the study were not readily available -- these studies were summarized in Bell and Leeworthy (1986); it is not known what type of sample design was used nor if specific questions about the value of beach protection were included.

It is hard to conclude much from the Curtis and Shows (1882, 1984) studies without knowing the specific details of the overall research design, including the sample design, questionnaire, and whether the investigators isolated and controlled for the economic value of recreational beach use relative to the economic value of beach protection. Compared to the Bell and Leeworthy studies reviewed, these estimates of beach use are higher in magnitude, but show the result that tourists were willing to pay more compared to residents as did the Bell and Leeworthy studies. Because these estimates only refer to recreational beach use and not to beach protection they are dropped from further consideration.

Bell and Leeworthy (1986, 1985, 1990). In one of the first studies to measure the economic value of beach use based on consumer surplus techniques, Bell and Leeworthy (1986) conducted a study of the economic importance and value of beaches in Florida. The study used a split sample approach, where the population was split into two groups, Florida-residents and tourists. Concerning residents, a two-part random sample and survey was used, the first part involved a telephone survey of a random sample of 1000 adult residents to determine participation rates in beach use, and the second part involved a telephone survey of a random sample of 911 adult residents to obtain information on use patterns, spending, and value from use. Regarding tourists, a total of 4,333 tourists were contacted as they exited the state via auto and airplane. Of this group, 826 were interviewed via a face-to-face survey for data on use, spending, and value from use. All surveys took place during 1984. Results of specific components of this study were published elsewhere (Bell and Leeworthy 1985; Bell and Leeworthy 1990), however, discrepancies of the reported results were found across studies (1985, 1990) with that of the main report (1986), thus the discussion that follows is based on the main report.

The study estimated the value of beach use based on both a CV method with an open-ended question format, and a Travel Cost approach. Results indicated that residents were willing to pay an average of $1.31/day per person and tourists $1.45/day per person based on the CV method

Table 1.

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(1984$, Table 1). Concerning the Travel Cost approach, the researchers first estimated demand curves for beach use, and then based on the average number of days used, along with other independent variables evaluated at their mean value, estimated the area under the demand curve above the average number of days used to calculate consumer surplus. These results indicated that economic value from beach use were estimated at $10.23/day per person for residents and $29.32/day per person for tourists (Consumer Surplus estimates - CS, 1984$, Table 1). One would expect benefits of beach use for residents to be smaller than nonresidents because residents are located closer to the beaches, costs of travel to the beach are lower for residents, residents have more access to beaches, and they have more alternative beaches to choose from than nonresidents. That is, residents face a rather unlimited supply of local beaches compared to tourists and accordingly will take advantage of this and use the resource more. Results of the Florida study illustrate this with residents spending an average of 14.68 days/year per person for beach visits compared to nonresidents who spent an average of 8.64 days/year per person for beach visits.

Because the Bell and Leeworthy studies did not address the value of beach protection these study results are dropped from further consideration.

Lindsay and Tupper (1989). In one of the studies that estimated the value of beach protection (i.e., erosion control, in general), Lindsay and Tupper (1989) conducted a study to determine three separate, but successive, economic values; 1) the value beach users place on their recreational use of the beach, 2) the value of beach protection in general, and 3) the value of having a litter cleanup program for beaches in New Hampshire and Maine. The study was based on a random sample of about 1100 beach users split over four coastal beaches in New Hampshire and Maine that were selected because of differences in physical characteristics across these beaches, (e.g., from undisturbed-natural environments to some urbanized features - close proximity to seasonal cottages/condominiums, presence of seawalls). The survey took place during the summer of 1988. The researchers used a CV method with an open-ended question format with face-to-face interviews to obtain estimates of economic value, i.e., WTP. Results indicated that the estimated WTP bid for recreational use averaged $47.40/day per person, the estimated WTP bid for beach protection (i.e., erosion control) averaged $30.80/year per person, and an estimate of the economic benefits for beach cleanup averaged $26.40/year per person (1988$, Table 1). If one were to assume a 92-day beach season (June-August), an estimate of the daily economic value from erosion control would be $0.33/day per person.

An interesting feature of this study is the finding that the mean estimates of economic value varied across all four beaches, which could reflect the difference in beach characteristics across these four beaches or difference in tastes, etc.. A limitation of this study is that the estimated mean benefits exhibit high variability, in the case of WTP for erosion control over twice the estimated mean value (i.e., the coefficient of variation was 2.233, which measures the relative dispersion of the mean WTP bids). Possible reasons for this could be the small sample size and/or that the survey used an open-ended WTP question. Furthermore, because respondents were asked to assess three types of values in successive order, an upward bias in the estimates of the second and third successive values could result.

Silberman and Klock (1988); Silberman, Gerlowski and Williams (1992). In a study of the economic benefits of beach protection in New Jersey, Silberman and others designed a study to compare a situation where beaches would undergo a beach protection project to beaches that would not so as to examine economic value of beach protection at Northern New Jersey beaches, published in two separate papers, (Silberman and Klock 1988; Silberman, Gerlowski and Williams 1992). The researchers also addressed the issue if economic value from providing beach protection should represent the sum of use and nonuse values, a concern to economists in general. The overall objective of the study was to assess economic value attributable to beach protection projects (i.e., beach nourishment projects) within the Sea Bright, NJ to Deal, NJ area, a 12-mile stretch of the northern New Jersey coastline. The study area ("recreational resource area") encompassed the northern NJ coast from Sandy Hook Gateway National Recreation Area through Belmar, NJ. Because the study's objectives were to assess both use and nonuse (existence) values attributable to beach protection, two separate research designs were used, one associated with the use value component, the other associated with the existence value component. Discussion of the existence value component will follow that of the use value component.

To assess benefits from beach use due to beach protection (use value), Silberman and Klock (1988) used a split research design where two separate groups of beach users were surveyed. One group was to represent the situation without beach protection ($B_{W/O}$), the other group the situation with beach protection (B_W). Estimates of economic benefits attributable to beach protection were treated as the difference between benefits estimated from the second group less those benefits of the first group (i.e., $B = B_W - B_{W/O}$). A split design was used to avoid introducing any upward bias in benefit estimates corresponding to a situation with beach protection (i.e., B_W) to avoid possible bias from successive order (a possible bias in the (Lindsay and Taylor 1989) study). One group was asked questions pertaining to existing beach conditions (i.e., situation without). The other group was asked questions pertaining to beach conditions as if a beach protection project were undertaken (situation with). The researchers then surveyed a random sample of beach users that represented both groups during the summer of 1985 via face-to-face interviews, but fail to cite the sample size of both groups. A contingent valuation approach based on an iterative bidding question format was used to assess economic benefits from beach use, i.e., use-values. Results indicated that beach users were willing to pay an average of \$3.90/day per person for beaches that would receive beach protection (B_W) compared to an average of \$3.60/day per person for beaches that did not receive beach protection ($B_{W/O}$), (1985\$, see Table 1). The difference, an average of \$.30/day per person (i.e., $B = B_{W/O} - B_W$), the researchers interpreted as an estimate of economic value attributable to beach protection. Before continuing one should note the similarity in the estimated economic value from beach protection in this study (\$.30/day per person, 1985\$) with that of the Lindsay and Tupper study conducted using a less sophisticated research design (\$.33/day per person, 1988\$). It is possible that bias from successive order is not measurable in small samples.

The component of the NJ study to assess existence value (or nonuse value) requires some discussion about the interpretation of existence value first. In simple language, existence value represents a value society places on a specific good, here, beach protection, when use is constrained to zero. In other words, a value for beach protection without use. Existence value is then interpreted as the value placed on the knowledge that beaches exist that are newly protected compared to beaches that are eroded for the segment of the population that would never visit or use these beaches. Hence, it represents a value of preservation versus no preservation for beaches in general. This component of the study was based on two independent samples and surveys, an on-site survey using face-to-face interviews of a random sample of beach-users, and a telephone survey of a random sample of 500 residents in 11 northern NJ counties and on Staten Island, NY. A CV approach was used in each survey but specific formats differed; an iterative-bidding format corresponding to the on-site survey and an open-ended format corresponding to the telephone survey. Silberman and Klock (1988) estimated existence value based on the on-site survey at an average one-time contribution of \$16.31 (1985\$, Table 1). If this represents an annual contribution, an estimate of nonuse value per day could be \$.177/day per person (based on a 92-day season, June-August). A shortcoming of this component of the study was that surveyed individuals were not given any alternative beach protection projects in other areas along the NJ coast to choose from; this fault could have caused an upward bias in the reported estimates. Furthermore, the researchers expressed concern that sampled beach users expressed difficulty in understanding the concept of existence value.

Silberman, Gerlowski and Williams (1992). A more detailed analysis of existence values by Silberman, Gerlowski and Williams (1992) was based on a comparison of estimated bids from the on-site survey and the telephone survey, and the difference in estimated bids of users versus nonusers from a statistical Tobit model where the independent variables were estimated at their mean values, i.e., $E(Y)_u - E(Y)_{nu} = XB_u - XB_{nu}$, where u=will use in future, nu=will not, E(Y) refers to the expected value of the dependent variable (existence value) and XB refers to the product of the design matrix of independent variables (the X matrix) and the parameters associated with the independent variables (the B vector). This specification is commonly used to describe regression models in standard textbooks of statistical and econometric methods (see Ostle and Mensing 1985, Johnston 1993). The researchers used a Tobit analysis since many zero responses were present (and ordinary least squares techniques yield biased estimates in such a case) and to control for the characteristics of use versus nonuse of beaches in the future, because existence value is only defined as a value when there is no use, and the on-site survey results contained "noise" as a result (see Judge et al. 1988 for more detail on Tobit models). The results based on the Tobit analysis indicated that estimates of existence value were an average of $15.10 from the on-site survey, and $9.26 from the survey of residents that were nonusers. The researchers concluded that the estimate from surveyed residents is a more appropriate estimate of the average economic benefit based on the existence of a beach environment preserved from erosion (1985$, Table 1).

Based on this study, if economic benefits are to be based on the sum of use and nonuse values, then benefits would be estimated as the sum of $.30/day and $.1006/day ($9.26/92-days in the season) per person or $.4006/day per user; but if benefits only represent use values then benefits would be $.30/day per person. One must keep in mind the limitations of this study in any interpretation. It was based on a relatively small sample size, causing a great deal of variation in the benefit estimates, survey respondents had difficulty in trying to assess a value for existence value of beach protection, and a choice of at least one or more alternative beach protection projects located elsewhere in NJ were not offered as alternative choices, which can introduce an upward bias in the reported estimates.

ACOE Reports. Further studies of the economic value of beach use come from ACOE unpublished surveys. Using the same survey data as in Silberman and Kloch (1987), Silberman et al. (1990), the ACOE provide more complete results concerning the survey of beach users only (U.S. ACOE 1989b). A random sample of beach users were surveyed by personal interview over the summer of 1985 (July - Labor Day, September) at all public beaches in the Sea Bright to Ocean Township (Loch Arbor) area with the exception of Deal. Benefit data were obtained based on a CV method using an iterative-bidding question format. Results from 2,917 surveys indicated a mean WTP bid of $3.67/person associated without shore protection, $3.89/person for shore protection with a 50 foot berm, and $3.93/person for shore protection with a 100 foot berm (Table 1, 1985 dollars; no estimates of variability for these mean values were given). Results pertaining to existence value, the value of preserving the beach, was estimated at an average of $16.41/year in 1985. From these results an estimate of value from beach protection is estimated to be $.22/person per day associated with a 50' berm, and $.26/person per day associated with a 100' berm; an

average of both sizes based on the midpoint of the two WTP-bids pertaining to shore protection is \$3.91/person [(3.89 + 3.93)/2], hence a net effect attributable to shore protection can be estimated at \$.24/person (\$3.91 less \$3.67) in 1985 dollars.
Another CV survey was conducted by the ACOE during the summer of 1987 for conditions of no project, a beach fill project with a 50 foot berm, a beach fill project with a 100 foot berm, and a beach fill project with a 150 foot berm (ACOE 1994a, 1994b). Unfortunately, results of this survey study were not contained in the report (ACOE 1994a, 1994b) nor were readily available.
Another ACOE study estimated recreational benefits based on a unit day value method for the area of Barnegat Inlet to Great Egg Harbor Inlet (Reach 7, 8 and 9), but found no recreational benefits to accrue (ACOE 1992). (A unit day value method basically consists of a monetary value of the net increase in users as a result of a project valued at a standard day trip expense or at a standard entrance fee.)

An ACOE reconnaissance report (1993) for the Raritan Bay - Sandy Hook (reach 1) area, used a unit day value method to obtain estimates of recreational benefits of \$2.88/day-trip with shore protection and \$2.40/day-trip without the project; a net difference attributable to shore protection of \$.48/day-trip (in 1982 dollars). Further ACOE reconnaissance studies did not consider recreational benefits (1991a and 1991b, 1994, 1995).

Koppel (1994); Kucharski (1995). In a recent study conducted at southern New Jersey beaches, Koppel (1994) and Kucharski (1995), examined the economic value of beach use. During the summer of 1994, beach users, business owners/managers, and homeowners were surveyed in a three part process in several southern New Jersey communities (Stone Harbor, Avalon, Atlantic City, Longport, Margate, Ventnor, and Brigantine). The first phase of the study involved beach users. A random sample of 1063 beach users were personally surveyed during the summer months (June, July, August, and Labor Day-September) of 1994. The study used a CV method, closed-ended referendum type question format to obtain estimates of the value of beach use in general (this represented a without project condition), an open-ended type question format to obtain estimates of the value of wider beaches (to reflect beach nourishment), and an open-ended question format to obtain estimates of the value of preserving the beach from erosion (i.e., existence value).

Survey results indicated that the recreational value of beach use averaged \$5.04/person per day when bids of zero dollars (i.e., \$0 bids) were excluded and \$4.22/person per day when \$0 bids were included in 1994 (Table 1).

Concerning the value of a wider beach, that is, the value of beach fill, 81% of the respondents indicated that they would pay the same, 16% were willing to pay more, and 3% indicated they would pay less (Koppel 1994:26). Of those willing to pay more, the average economic value was estimated at $2.72/person per day above the initial use value estimate, and for those willing to pay less, the average value was estimated at $1.68/person per day below the initial use value estimate in 1994. On the basis of this information a weighted average of the economic value of a wider beach was estimated to be $4.59/person per day with $0 bids (i.e., $6.94*165 + $2.54*33 + $4.22*865 = $4879.22/1063 = $4.59) and $5.41/person per day without $0 bids (i.e., $7.76*165 + $3.36*33 + $5.04*865 = $5750.88/1063 = $5.41) (author's calculations). On average, these beach users were willing to pay an additional $.37/person per day for a wider beach in 1994 dollars (for both cases, including $0 bids and excluding $0 bids, i.e., $5.41-$5.04=$.37, and $4.59-$4.22=$.37).

Concerning the section of the study (Koppel 1994) associated with existence value, results indicated that the estimated median value was $50 in 1994 dollars (the original report did not contain any other point estimates of central tendency of sample distributions such as the mean nor estimates of the variability). Assuming a 92-day season, nonuse value is estimated at $.5435/day. This would yield an overall economic value (sum of use and nonuse value) of $.9135/day. However, because mean values are preferred measures of central tendency of sample data, and the fact that the researchers did not examine effects of protest bids and outliers, the estimate of nonuse value will not be considered in the remainder of this chapter.

The second phase of the Koppel (1994) study involved a survey of business owners. General information as well as economic value was obtained from a survey of 156 businesses. Economic value of beach protection was based on an open-ended CV question format from face-to-face interviews. Results indicated that business owners were willing to pay almost 20% more in taxes (19.95% more) for a wider beach, and an average $181/year per business with $0 bids or $256/year per business without $0 bids in 1994 (authors calculations). As a result of the small sample size, little confidence can be placed on these responses and they will not be considered for further analysis.

The third phase of the Koppel (1994) study consisted of a survey of 621 homeowners. Survey results found that 80% of the homeowners were <u>not</u> willing to pay more in taxes/payments for a wider beach (i.e., beach protection), 17% were willing to pay more, and 2% indicated they would pay less. This is surprising because homeowners are one group that would gain the most from shore protection efforts. If the sample were stratified on the basis of proximity to the beach, responses might have been different. Survey results indicated that the midpoint of the estimated median value of households willing to pay for a wider beach was $35.50/household with $0 bids ($25 - owners surveyed at home, $46 - owners surveyed at the beach) or $229.50/household without $0 bids ($380 -owners at home, $79 - owners at the beach) in 1994. This also represents a relatively low sample size; 1.5% of all available homes in these communities. Again, little confidence can be placed on these estimates and these estimates will not be considered for further analysis.

In addition, the Koppel (1994) study conducted two separate surveys of beach users for the communities of Brigantine and South Stone Harbor (results of South Stone Harbor were not provided in the report, but, it is believed similar information was obtained). The Brigantine survey represented the need to obtain specific information for the ACOE concerning perceptions of beach use and beach protection; information about economic value was not included in this survey. Information collected and contained in the report (Koppel 1994) related to perceptions about physical appearances of different beach nourishment projects.

Kucharski (1995). In a subsequent analysis, Kucharski (1995) in an unpublished masters thesis, used the estimates cited above and projected them to obtain estimates in 1994 for: 1) all beaches in the 5 communities, 2) all homes in the 5 communities, and 3) all businesses in the 5 communities. Projected estimates in 1994 were almost $101 million for the economic value of beach use, $4.8 billion in lost property value from beach erosion to homeowners, $2.5 billion for existence value of beach protection to homeowners, and $1.4 million for existence value of beach protection to businesses (all in 1994 dollars).

Limitations of the combined study effort (Koppel 1994, Kucharski 1995) follow. Neither study provided estimates of the variability of the estimated average and median sample values along with estimates of a range of values when appropriate; this weakens the overall study and limits comparisons with other studies. The relatively small sample size of homeowners and business owners/managers raises questions about the representativeness of the data and its variability. Both aspects limit the usefulness of the data; without some idea of this information one cannot place much confidence on the estimates, projected or otherwise. Concerning the economic value analysis, the data were not tested for outliers and protect bids (both can result in a significant bias of point estimates, i.e., the first and second moments of a sample distribution) and the inclusion of outliers and protect bids can bias the estimates upward and increase their relative variability. The result is high sample estimates that are highly variable which one can place little confidence on. Furthermore, Kucharski (1995) fails to cite other comparable economic studies based on surveys of beach users as well as other studies of the economic importance of beach use and shore protection. In both reports (Koppel 1994, Kucharski 1995), neither investigator discusses possible reasons for limitations of the study and of the study results, which is a standard practice among investigators.

More troubling are the projected estimates from Kucharski (1995). Throughout the report there is a lack of discussion about the theoretical framework used, the research design of the study and its survey instrument, the sampling framework, and an appropriate discussion about the derivation of the descriptive sample statistics, and possible shortcomings of the estimates. The projected estimates are highly questionable being based on relatively small population samples, and hence, little can be concluded from this study.

For the purposes of this report the following studies are used to derive a range of estimated average values associated with beach protection: 1) northern NJ (Silberman and Kloch 1988, Silberman et al. 1992); 2) southern NJ (Koppel 1994); 3) NH-ME (Lindsay and Tupper 1988); and 4) northern NJ (US ACOE 1986). The net economic value from beach use is estimated as follows: from (1) $.30/person per day in 1985 ($.39/person per day in 1992 dollars), from (2) $.37/person per day in 1994 ($.35/person per day in 1992 dollars), from (3) $.33/person per day in 1988 ($.39/person per day in 1992 dollars), and from (4) $.24-$.26/person per day in 1985 (or $.32-$.34/person per day in 1992 dollars). Based on these estimates a low estimate of net economic value is about $.35/person per day in 1992 dollars (from (2) and (4)), and a high estimate of $.39/person per day in 1992 dollars (from (1) and (3)). Hence, the net economic value associated with beach protection for recreational use is estimated to range from $.35/person per day-trip to $.39/person per day-trip in 1992 dollars.

Beaches, Tourism and Economic Development

Recently, a series of articles have begun to examine the issue of the role of beaches in tourism activity, economic activity, and in economic development (Stronge 1994 and 1995, Houston 1995a and 1995b). Because these articles have appeared after the 1981 NJSPMP, some discussion is necessary. The basic theme of these articles is that tourism expenditures in beach communities is attributable to the presence of the beach and that spending can significantly contribute to local, regional, and possibly, national economies. Although one can find little to debate about the general nature of tourism in beach communities, two claims of these researchers that are open for debate is 1) whether or not spending in beach/coastal communities contributes significantly to local economies and/or state/regional/national economies, and 2) if all tourism expenditures are directly related to the presence or proximity of the beach.

Regarding the issue of the association among tourism spending and proximity of the beach, this is basically a sampling issue. In New Jersey, counties such as Monmouth, and Ocean counties extend well inland from the shoreline, in excess of 30 miles in some areas (this is also true of some coastal counties in Maryland, Connecticut, and Massachusetts, for example). Within coastal counties, then, tourism spending in areas that are not located in close proximity to the shoreline and beach are probably not influenced by the beach, that is, there is no beach effect in these cases, and one can expect that these expenditures would occur regardless if the tourist attractions or business entities were located in close proximity to the shoreline or were located far inland. The use of county-level statistics and county expenditure data, then, can be misleading in that it contains an unknown portion of economic activity that is located well inland (i.e., not in close proximity to the shoreline) that has no beach effect, with the effect of introducing an unknown, upward bias in county-level statistics. For example, should sales made at shopping malls located 30 miles inland while on a visit to the beach be included as beach trip expenditures? Or should economic activity from business units located inland and included in county-level data represent coastal economic activity? (Such data were used in a recent assessment of the National Coastal Zone Management Program as representative of coastal economic activity (Univ. North Carolina 1991). Use of such data does not connote endorsement; it can lead to strong upward biases and portray a misleading picture. Research effort should be placed in developing more appropriate data.) Without knowing the distribution of economic activity within particular coastal counties, it is not possible to determine the amount of economic activity such as tourism spending associated with a beach effect from the remainder of the county-level activity, nor the magnitude of the upward bias in coastal county-level data if used for the purpose of representing coastal economic activity. This limits the usefulness of county-level data and researchers should use caution in their use and interpretation of county-level data.

A number of points should be kept in mind when considering the role of coastal tourism in local/national economies. One concern is the purpose of the trip; a specific trip made for the purpose of beach recreation is a distinct trip, a trip made to visit friends/relatives and recreational attractions not located at the shore area coupled with some of the time spent at local beaches is a multi-purpose trip. One must be careful to account for the time or proportion of the trip that was only spent at the beach, or that involved a specific trip to a beach. (The time/proportion of the trip not spent at the beach is irrelevant.) Another concern is to identify expenditures that are uniquely related to the presence of the beach (and or beach trip) or related to the proximity of the beach. This problem becomes compounded for multipurpose trips. A case could be made whether expenses other than lodging, food, entertainment, transportation, entrance fees (parking or beach) should not be directly related to beach use activities. For example, should expenses of durable and nondurable goods (small appliances, clothing other than beach apparel) made because of shopping convenience and leisure time be included as typical expenses from beach trips. Studies that have examined impacts of tourism to local economies discussed below, are all based on field survey data. The use of surveys and survey data, and sample design introduces concerns. In these studies and in future attempts, one needs to identify only relevant expenditure items made by beach tourists/users, and determine the appropriate trip expenses or proportion of total trip expenses due only to beach related trips/visits before tourist expenses are projected. Such a process will avoid the problem of artificially inflating projections of tourist expenditures. For example, if only 50% of total expenses are relevant and pertain only to beach use from a particular survey, projected estimates of total expenses for a region/state would then contain an error of 50%; the sample and projected estimates should be reduced by half. Care must be used in developing any projections of sample-survey data, because the projected estimates, in turn, form the basis of arguments of the relative contribution of coastal tourism to local/regional economic activity.

Stronge (1994, 1995). In two papers, Stronge (1994, 1995) advances the case for the importance of beach tourism in relation to shore protection, although this issue was first addressed by Bell and Leeworthy a decade earlier, in the same journal (1985, 1986, 1990). (None of these references are cited by Stronge.) Stronge (1994) used survey data from the Florida Department of Tourism to advance the case for the economic importance of beach tourism. In the survey and in the article, beach tourists were identified on the basis of a response to a question about what particular facilities and programs they enjoyed during their visit/trip. Beaches were one of the options tourists could check off; those that checked off this category were classified as beach tourists. Economic impacts were estimated on the basis of the average expenditure of beach tourists, the percent of surveys that had the response of beaches checked off (to represent a participation rate), and statewide multipliers obtained from the U.S. Bureau of Economic Analysis Regional Input-Output model. The economic impact from direct spending of beach tourists was estimated at $7.9 billion in 1992 in Florida. Other economic impacts estimated pertained to output (i.e., sales), earnings (i.e., income) and employment (jobs). Stronge then claims that the contribution of beach tourism to Florida's GDP (referred to as Gross Regional Output in the paper) was estimated at $15.4 billion; this estimate comes from the economic impact estimate of output (1992; Table 2, pg. 7 and pg.8). This claim is simply wrong, economic impacts of sales that are based on multipliers contain double-counting and do not represent GDP measures (see the discussion in the first chapter on the misuse of economic impact measures). It was unfortunate that such a claim was made by an economist, but the damage was already done, and Houston (1995a and 1995b) cites Stronge's estimates as fact.

Houston (1995a and 1995b). Houston (1995a and 1995b) further extends the arguments of the impacts of beach tourism following Stronge (1992). In both papers, Houston takes the Stronge result, compares it to overall tourism spending, estimates a ratio between beach tourism spending and overall tourism spending, and projects beach tourism spending on the basis of this ratio for an estimate of the beach tourism portion of the state GDP, an estimate of $170 billion for all coastal states in the U.S. (Houston 1995a). As in Stronge (1992), this projected estimate is based on economic impact measures and contains double-counting. It is not to be interpreted as a measure of GDP. Unfortunately, the press tends to sensationalize such estimates which will only cause confusion about the importance of beach tourism in the future.

Notwithstanding that the nature of tourism in coastal areas can create impact effects (spending effects over and above residents' spending) and possibly contribute to economic development if the tourism effect is large enough, several shortcomings of the Stronge and Houston papers weaken their results and deserve discussion, besides the obvious misinterpretation of economic impacts as aggregate economic activity measures (i.e., GDP). The Stronge paper identified beach tourists on the basis of whether or not tourists enjoyed Florida beaches during their visit to Florida. Such information is misleading, it does not state whether or not tourists actually did visit or spent time at beaches in Florida during their visit. Such a procedure can identify both users and non-users. More appropriate information would consist of the number of beach trips (day-trips) taken during the visit or the portion of time spent on the beach and/or on beach trips (either the number of days or the percent of the total visit). It is surprising that this issue is not even mentioned by Stronge.

Concerning the Houston papers, further limitations that weaken the analyses are the following. Houston uses statistics from secondary, unofficial sources such as The World Almanac, and press reports (USA Today, National Geographic, Wall Street Journal). Secondary statistical sources are usually not tested and examined for accuracy as are official statistics published by various branches of the government. Therefore, secondary statistics can be quite misleading and can even portray the wrong picture. The potential bias and error inherent in secondary source statistics limits the accuracy and usefulness of any research based on such data.

A general word of caution is necessary about the results of the Stronge and Houston papers (similar remarks apply to Kucharski 1995). One can conclude little from these papers, the research has introduced unknown, upward biases in their estimates; this limits the usefulness of these studies, and raises questions about their estimates. Research of this type will only cloud the issue of the importance of beach tourism vis a vis shore protection provision. In order for future studies to be useful, investigators should be unbiased and interested in the problem rather than the answer. The studies should be rigorous, based on accepted research approaches and designs, and use appropriate statistical data, otherwise only confusion will be the result. It is hoped that future researchers will benefit from this hindsight so that future studies will not fall into the same trap as these studies have.

Bell and Leeworthy (1985, 1986). Because of the interest in the economic importance associated with beach use, an earlier study by Bell and Leeworthy (1985, 1986) discussed above, will be discussed in detail at this point. Bell and Leeworthy (1985, 1986) were the first investigators to conduct a detailed analysis of the net economic value of beach use <u>and</u> the economic importance of beach use for an entire state, the state of Florida. Bell and Leeworthy conducted a study based on surveys of residents and non-residents. A two-part telephone survey of a random sample of residents 18 years and older was conducted. The first part, a sample of 1000 adults, was designed to determine the participation rate of beach use in 1983. The second part, a sample of 911 adults, was designed to obtain information on beach and travel behavior, and travel expenses in 1983 (a 9 month period in 1983, and a 3 month period in 1984). (It would have been preferred to have a complete calendar year rather than a split year, but it is suspected that respondents interpreted the phrase "in the past 12 months" to refer to the 1983 calendar year.) For the purposes of this report it will be assumed that the survey data represent the the 1983 calendar year.

The survey of non-resident tourists involved adding a number of questions to the State tourism survey in a two-part design. The first part involved a cover tally sheet to determine the participation rate for beach use among non-residents, a sample size of 4333 adults. The second part was designed to obtain information about beach and travel behavior, and expenses involved from a sample of 826 respondents that participated in beach use. Non-residents were personally interviewed at major exit sites (airports and auto travel sites) during 1984 (January-November). A similar problem arises with the non-resident tourist survey data concerning the time frame the data represent. For the purposes of this report it will be assumed that the expense data reflect the 1983 period.

Overall survey results indicated that an estimated average of $450/household per year was spent by residents, and an average of $395/household per year was spent by non-residents that visited Florida beaches in 1983. The estimated average travel expense was projected on the basis of the participation rate (inverse of participation rate times the average travel expense), to yield total expenditures associated with beach use estimated at $2,276 million in 1983 ($1,123 million for residents and $1,152 million for non-residents). These total expenditures are referred to as total sales impacts by Bell and Leeworthy; this is a slightly misleading term because this estimate reflects actual sales directly related to beach use and not impacts resulting from these sales. Economic impacts are then derived in terms of output (i.e., sales) , employment (i.e., jobs), wages (i.e., income or earnings), and state tax revenues. However, the impacts are not derived in the typical manner; impacts for residents are not based on input-output methods but are projected based on ratios, and an export based theory is used to derive impacts for non-residents (Bell and Leeworthy 1986: 8-10, 19-25). Total sales impacts were estimated at $4,581 million from total expenses of $2,276 million in 1983.

Limitations of the Bell and Leeworthy (1986) study concern the derivation of economic impacts; an input-output methodology was not used for resident's impacts and a non-conventional input-output methodology was used for non-resident's impacts. It is preferable to base the economic impacts on standard input-output models of a particular state. Bell and Leeworthy claim that only tourist (non-residential) expenses generate induced effects; this simply is not correct. Expenditures of all individuals that travel to a local area such as a beach-community will generate both direct effects (i.e., economic activity of spending to primary industries - sales of industries in primary sectors), indirect effects (i.e., additional economic activity generated from the primary sector to industries in secondary sectors), and induced effects (i.e., further economic activity from the secondary sectors to tertiary sectors and beyond; that is, money respent by the secondary sectors). This is a standard multiplier effect in input-output techniques where there are multiple rounds of impacts generated from initial expenditures as the money travels throughout an economy (Leontieff 1966). Other limitations are related to the small sample of 911 residents and 826 non-residents, which can affect how representative these samples are to the general population of residents and non-residential Florida travelers. That is, whether these sample statistics can reasonably approximate the population statistics, as well as the variability of these sample estimates (because large variances can occur with small samples). However, Bell and Leeworthy correctly point out the need for a two-part survey process; the first part to obtain estimates for participation rates. Additionally, the researchers collect data on beach use and expenses and adjust the data on the basis of the portion of time actually spent at the beach (or on the beach trip). This is necessary when trips are multipurpose in nature.

On the basis of the Bell and Leeworthy study, total sales were projected at $2.27 billion and sales impacts were estimated at $4.58 billion to the state of Florida in 1983 ($3.206 billion and $6.452 billion, respectively in 1992 dollars; Bell and Leeworthy 1986: 30). Stronge (1994) projected total sales of $7.9 billion from beach tourists, and output (sales) impacts of $15.4 billion in 1992. The Bell and Leeworthy estimates still differ from the Stronge estimates by 2.5 times less for projected sales and 2.4 times less for sales impacts (all in 1992 dollars). This emphasizes the reason for the concern over the use of survey studies, and the need to isolate expenses just for the portion of the trip dedicated for beach use. Projected expenses of beach use can become easily inflated and unrepresentative as in the Stronge and Houston papers.

<u>Manheim and Tyrrell (1986a, 1986b)</u>. An additional argument about the effects of tourism on coastal communities has been advanced by Manheim and Tyrrell (1986a, 1986b). Manheim and Tyrrell have argued that the influx of non-resident tourists during the summer season places an added, and previously ignored, burden on residents because of non-residents' use of the local infrastructure, that in many cases is developed based on the needs of local residents and paid for by the local residents through property taxes. The influx of summer populations in beach communities literally explode and the local infrastructure (roads, water, sewerage, waste hauling)

either wear out or exceed their designed capacities more quickly. These costs are not internalized nor borne by the non-resident tourists, although they are for individuals that own second, summer homes. The issue mainly concerns the proportion of tourists that use hotel, motel accommodations in relation to owner-occupied homes and apartments. Previous studies have not considered this aspect of tourism, and communities that advocate tourism need to take these hidden costs into consideration.

ACOE Studies of Shore Protection

A detailed review of ACOE studies of proposed projects in New Jersey was beyond the scope of this paper. The reader is referred to each of the individual reports (U.S. ACOE 1989a, 1989b, 1991a, 1991b, 1992, 1993, 1994a &,1994b, 1994c, 1995). In general , the ACOE analyses and economic analyses including the CBA are thorough and well done. A brief overview of typical ACOE studies and analysis will be useful. Development of the cost component is very detailed and thorough, accounting for all items involved with the project in question. Many of these cost items are based on detailed engineering studies. The benefit component is also very thorough and well done in general. All recent ACOE studies develop economic benefits to consist of up to 5 items:

1) storm reduction benefits,
2) benefits from the reduction in lost land,
3) benefits from intensification,
4) recreation benefits, and
5) benefits from reduced maintenance and costs of shore protection at other sites.

Storm reduction benefits, the first item, measures benefits as the reduction in storm-related damages prevented by the proposed project (i.e., storm damage w/o (without) the project <u>less</u> storm damage with the project). Though this definition is quite simplified, storm reduction benefits can consist of up to 5 distinct components and involve sophisticated computer models to develop estimates. These five components can be: 1) reduction in the inundation of structures, 2) reduction in damage caused by wave attacks to structures, 3) reduction in damage associated with long-term erosion and storm events (storm recession), 4) reduction in maintenance costs associated with other shore protection projects, and 5) reduction in public emergency costs that would arise from storm/flooding emergencies. To avoid double counting of storm reduction benefits, the ACOE use a critical damage threshold, whereby only the maximum damage to any single structure pertaining to the first three components is used for storm-related damage and as the benefit estimate of storm reduction benefits.

The second benefit item, reduction in lost land is the reduction of the assessed value of real property that would be lost from erosion prevented by the project (i.e., the assessed value of land lost w/o the project less the assessed value of land lost with the project) plus the value of the recreational component of the lost land when the lost land is identified to be beach/recreational land (i.e., derived from an estimate of the amount of beach users the lost land would have supported over the beach season valued as the sum of beach fees plus the economic value of beach use based on WTP without project conditions). Intensification benefits, the third benefit item, are benefits due to increases in the assessed value of real property related to the presence of the proposed project. The forth item, recreation benefits, consist of the sum of the net increase in economic value (i.e., measured as willingness-to-pay) from a wider/protected beach for current beach users, the net increase in the economic value of additional beach users from a wider/protected beach, and the economic value from preserving the beach (i.e., existence value) from non-users (i.e., the sum of use and nonuse values). Most current ACOE studies use the Contingent Valuation method, although some studies use a unit day value method (a monetary value of the net increase in users as a result of the project either valued at an average day trip expense or at an average entrance fee). The fifth item pertains to benefits from reduced maintenance of shore protection at other locations in close proximity to the location of the proposed project (i.e., derived as the maintenance costs of shore protection at nearby locations without the project less estimated maintenance costs of shore protection of these nearby locations with the project). It should be pointed out that these benefit items used in ACOE analyses may be subject to debate and should not be taken as fact. For instance, the third benefit item, intensification benefits, implies that benefits arise from increases in the assessed value of real estate in close proximity of shore protection projects. Not all coastal researchers may agree with this claim nor have studies been conducted to rigorously examine and quantify this effect. Similar comments may apply to the remaining benefit items used in the ACOE analyses.

Limitations of ACOE studies concern: 1) inadequate sensitivity analysis of benefit items; 2) lack of a sensitivity analysis of cost items; and 3) little and inadequate treatment of uncertainty in cost and benefit items, although some of this is conducted regarding the estimation of storm reduction benefits (through the use of storm damage - wave surge computer models to simulate storm damage); the treatment of risk and uncertainty should be more explicit in ACOE studies; 4) no treatment of risk involved with project lifespans and project outcomes (this is an area where there is much room for improvement); and 5) little or no research to support and validate the specific claims of benefits realized from shore protection.

Recommendations for future ACOE studies pertain to both cost and benefit components as follows: 1) incorporation of uncertainty in cost and benefit items; 2) incorporation of risk in project lifespans and project outcome (e.g., more accurate estimates of lifespans and outcomes based on local experience); 3) greater coverage/application of sensitivity analysis to derivation of cost and benefit estimates; and 4) future studies should be performed to address the appropriateness of the benefit elements included in ACOE procedures.

The treatment of uncertainty involves two basic components. One concerns benefit and cost items, the other concerns the lifespan of shore protection projects. Regarding the cost and benefit items, elements of uncertainty pertain to the frequency of occurrence of cost and benefit items, and uncertainty over future monetary value of cost and benefit items. There are some elements of costs and benefits of proposed shore protection projects that are stochastic in nature; this affects both the frequency of occurrence as well as the magnitude of the estimate for cost and benefit items. For example, over a 10-year period, some cost and benefit items may only occur 1 or 2 times in 10 years due to the occurrence of significant coastal storms; the magnitudes of costs and benefits can also be highly variable (e.g., by orders of magnitudes) at these times in comparison to non-storm conditions. In future studies, both of these elements of uncertainty (frequency of occurrence and variability of magnitudes) should be incorporated into ACOE analyses rather than the use of average magnitudes and occurrences over a given time period. It is preferred to have some idea of the range of damage estimates and range of storm damage reductions rather than a point estimate such as an average value. (The point needs to be emphasized. In CBA it is preferred to have as realistic a situation as possible. If, for example, certain cost and benefit items only occur 1 or 2 times in a 10 year period, this needs to be reflected in the CBA. Also, when these cost and benefit items occur, their magnitudes will be highly variable and could differ by orders of magnitudes compared to the remaining 9 or 8 years. This aspect should also be incorporated in CBA. All too often, the investigator uses the average value over the 10 year period as if it occurs in each period. This practice detracts from the realism a CBA should reflect.) As an example, in the analysis of recreational benefits (ACOE 1989b), ranges (upper and lower bounds and a mean) are developed in the analysis (see pages D-88, D-89). However, in the final analysis of Benefit-Cost ratios this range is dropped and the ratios and CBA are based on the mean value.

Furthermore, uncertainty over the future monetary value pertains to estimates of the value of cost and benefit items when the monetary value can vary over time due to inflation and economics of scale. This element should also be incorporated into future ACOE analyses.

Incorporation of risk elements concern the expected project lifespan and the expected outcome. Both factors are not known with certainty, and there is a risk that projects may fail to achieve their expected lifespans and/or expected outcomes, for example a 10% probability that the project fails (in terms of lifespan and outcome), a 20% chance of failure, etc. based on expectations of the occurrence of significant coastal storms over the project planning period. These elements should be incorporated into future ACOE analyses. This recommendation must also include an effective monitoring program in which the relative effectiveness of the project can be measured, both in terms of achieving its expected outcome and in achieving its expected lifespan.

The third major recommendation is about expanded application of sensitivity analysis in the derivation of cost and benefit estimates. The only sensitivity analysis in ACOE analyses pertains to the use of a range of discount rates in the present value analysis of net benefits. Sensitivity analysis could be useful in evaluating project outcomes for different scenarios where both cost and benefit estimates take on a range of values. For instance, a range of net benefits for different storm event scenarios, e.g., net benefits for low storm activity, moderate storm activity, and high storm activity.

Other recommendations of future ACOE analyses concern the following: 1) incorporation of some measure of the variability of the cost and benefit items, 2) use of better damage data from more recent storm-events as well as the commonly cited 1962 and 1984 "super" storms (here more recent data from FEMA and the NFIP agencies are useful), 3) recreational benefits from increased use should incorporate costs of building additional parking facilities to accommodate the new users as well as if expanded parking facilities are possible and associated with the estimated increased use. In New Jersey, beach use is often limited by parking facilities and/or the absence of parking facilities. Furthermore, there is little opportunity and space to expand parking facilities, and costs of congestion at beach sites and for travel times that such increased use would impose (will the increased number of beach users on the proposed wider beach result in the same use density or a higher use density?); 4) also some sensitivity analysis of the distribution of increased beach users over the season to contrast with different types of seasons (i.e., differences in weather factors, water temperatures, will affect beach use patterns; do we expect that all seasons will be the same over a 10 year period (such an assumption is presently made in ACOE analyses)? Then a CBA should be based on a scenario of the proportion of seasons with average weather conditions, above average weather conditions, and below average weather conditions).

CBA of proposed shore protection projects should consist of the following overall approach. CBA should be based on the present value of the expected value of: 1) costs, 2) benefits, and 3) net benefits over a range of significant coastal storm conditions (e.g., severe (>5 in 10 years), mild/average (3 in 10 years), light (1 in 10 years), based on past history when appropriate), and over a range of probabilities of project failure, and pertain to a range of estimated seasonal conditions that would affect the benefit estimates over the proposed project period. Over the past three decades, for example, 5 significant coastal storms occurred during the 1960-70 decade, 6 during the 1970-80 decade, and 7 during the 1980-90 decade. From the data in 1990 so far (12 significant coastal storms over 1990-96), the 1990's appear to be a decade of high/severe activity.

Expenditures and Impacts of Tourism on the New Jersey Shore

Studies regarding the effects of spending by tourists in shore communities are useful because statistics on business sales and activity are hard, if not impossible, to disaggregate into sales for shore communities and sales for non-shore communities. Limits to this data are that not all business sales and activity are measured, non-tourist expenditures remain unknown. One also needs to be aware of the distinction among actual expenses from economic impact effects, and if expenses represent direct sales versus indirect sales. (Here, the reader is referred to the second chapter for a discussion of terms and concepts, and to the previous section for relevant concerns.)

A number of studies have been conducted for the State of New Jersey, Division of Travel and Tourism that have examined the tourism sector, tourism spending and economic impacts of tourism (RL Associates 1987, 1988, Opinion Research Corporation 1989, Longwoods International 1992, 1994, 1995). Discussion of these studies is warranted for several reasons, 1) these studies have generated a great deal of interest from the public concerning the tourism sector, especially regarding the Jersey Shore area, 2) coastal researchers are rediscovering the importance of coastal tourism and are trying to establish some link between shore protection spending and spending generated from coastal tourism, and 3) these studies and interest appeared after the New Jersey Shore Protection Master Plan was completed.

As with any study of the tourism industry that generates impacts, some caution is advised in the interpretation of the results. A complicating issue concerning the New Jersey tourism studies is that the three different organizations used a different approach, different sampling technique, and weighting (or projection) technique. These factors limit comparisons across studies.

RL Associates and Opinion Research Corporation. The first study funded by the State of New Jersey to determine the effects (or impacts) of tourism on the New Jersey Shore was conducted in 1987 by RL Associates (RL Assoc. 1987). A random sample of all households located in non-shore counties in New Jersey, and in local areas in New York, Delaware, Pennsylvania, Ohio, and Maryland were interviewed via telephone. The same approach was used in their 1988 study of the Jersey Shore (RL Assoc. 1988). Opinion Research Corporation (1989) also conducted a telephone interview of a random sample of households in the same areas but used a different random sampling design than did RL Associates. This in turn affects how the sample data were projected (weighted) to generate state estimates of tourism expenditures. Because of these differences (other differences exist in relation to the Longwoods approach) one cannot compare the projected estimates across studies; these studies can only be used as point estimates of tourism activity but not for comparison purposes. (Undoubtedly, this limitation has caused the State of New Jersey much frustration which would like to compare such data over time -- hence the reason why Longwoods was contracted to perform four consecutive studies.) A further problem concerning these three studies involves the research design. In any study of behavior where participation is a key factor such as in recreational activity and in travel and tourism, the research design should include a segmented sample design (i.e., a two-part sample) as the travel-tourism study conducted by Bell and Leeworthy (1986). The first part is to determine the participation rate, which determines the projection (weighting) factor, while the second part obtains the sample data on use characteristics and expenditures. The fact that neither RL Assoc. nor Opinion Research Corp. discuss this approach in relation to that used, should raise concern and question the confidence of the projected estimates.

Because of the problem of different designs across all three studies, Opinion Research Corporation in their 1989 study reprojected (i.e., reweighed) the sample data from the two previous RL Associates studies using techniques that were as similar to those used in their 1989 survey study so that comparisons could be made across all three studies. With these caveats in mind, results from Opinion Research Corp. (1989) indicated that an estimated $6.2 billion was spent by tourists that traveled to the Jersey Shore in 1987, an estimated $5.4 billion in 1988 and an estimated $7.4 billion in 1989 (see Appendix Table 1). As one will see the estimates from the Longwoods studies for the Barrier Island component are significantly smaller by a factor than these estimates, hence, another reason why the studies cannot be compared.

Longwoods International. A series of studies were funded by the State of New Jersey and conducted by Longwoods International of the travel and tourism industry in New Jersey beginning in 1991 (Longwoods Int'l. 1992, 1994a, 1994b, 1995). The Longwoods studies used an entirely different design from most studies of tourism; they conducted a two-part survey, one of establishments and one of tourists. The first-part was used to collect data on lodging expenditures from establishments to increase accuracy and to avoid recall error. The second-part was used to collect sample data on tourism expenditures so as to determine the proportion of travel and tourism expenditures associated with specific types of accommodations used (e.g., hotels, campgrounds, state parks, friends/relatives, day trips, and pass throughs). Once the accommodation expenses were projected (from the first-part survey) the remaining expenditure categories were derived on the basis of the proportion of all expenses they accounted for (for example, if hotel expenses were projected to $15 million, and if hotel expenses represented 38% of the total expense of tourists that stayed at hotels, then total expenditures are projected to be $39.47 million ($15 mill./.38). By knowing the proportion that the remaining expense categories represent of the total, estimates for these categories can be derived, if food/restaurants represented 25% of the total, its estimate would be $9.87 million ($39.47*.25) and so on).

Another difficulty with the Longwoods study is that the projected estimates are on a county-level basis. Such county-level data cannot represent specific areas such as a coastal zone, i.e., a narrow area in close proximity to the the coast. In order to be able to isolate such an area from county-level data, one would need to know the distribution of retail establishments/businesses and the distribution of economic sales on a location basis within the entire county (e.g., municipality basis); such information is either not available or not readily available. This method would still be subject to error. As a result of this difficulty, Longwoods included a separate survey component within their overall effort to isolate tourism spending activity in the Jersey Shore area, i.e., Barrier Island component. Statements about the effect of tourism on the Jersey Shore can then be made, but only in reference to this Barrier Island component.

Longwoods estimated that travel and tourism expenditures in the State of New Jersey represented \$18.28 billion in 1990 (\$18.83 billion in 1992 dollars), \$17.84 billion in 1991 (\$18.37 billion in 1992 dollars), \$18.6 billion in 1992, \$18.91 billion in 1993 (\$18.36 billion in 1992 dollars), and \$22.65 billion in 1994 (\$21.44 billion in 1992 dollars) (Table 2). Keep in mind that these estimates represent state totals. Concerning the coastal counties of Atlantic, Cape May, Monmouth, and Ocean, estimated totals were \$9.1 billion in 1990 (\$9.4 billion in 1992 dollars), \$8.9 billion in 1991 (\$9.1 billion in 1992 dollars), \$9.6 billion in 1992, \$9.7 billion in 1993 (\$9.4 billion in 1992 dollars), and \$12.56 billion in 1994 (\$11.89 billion in 1992 dollars). If one treated gambling activity as not dependent on the coastal area, then the 4-coastal county totals excluding expenditures on gambling would represent \$6.5 billion in 1990, \$6.4 billion in 1991, \$6.8 billion

Table 2.

Table 2 Cont.

Table 2 Cont.

in 1992, $6.5 billion in 1993, and $9.3 billion in 1994 (Table 3). Even these figures do not represent travel and tourism activity at the Jersey Shore and the above discussion regarding the misuse of using coastal county-level data to represent coastal tourism activity is appropriate, namely because coastal county data represent inflated economic activity if used as coastal tourism economic activity. (Note that these estimates are within the same range as those produced by the earlier RL Assoc. and Opin. Rsch. Corp. studies, hence, the earlier studies might represent county-level totals, and hence, represent inflated estimates of coastal tourism economic activity.)

Estimates developed for the Barrier Island component, however only represent one component of beach travel and tourism activity (i.e., that portion of tourists that rented accommodations along the Jersey Shore), and underestimate the level of travel and tourism activity associated with beach travel (other components of beach travel consist of other overnight trips <u>and</u> day trips). In 1992 an estimated $740.5 million was spent by tourists and travelers that stayed at barrier island rental units (the first year data were collected), $874.9 million in 1993 ($849.5 million in 1992 dollars), and $817.3 million in 1994 ($773.3 million in 1992 dollars) (Table 2). In 1994, the barrier island component represented 6.8% of total tourism expenditures of the four coastal counties, and 3.6% of the state tourism expenditure total. Expressed in terms of a three-year average (1992-94), tourism expenditures of the Barrier Island component accounted for an estimated $787.9 million a year in 1992 dollars or 7.6% of a similar 3-year average of the 4-coastal county tourism expenditure total ($10,314.66 million/year) and 4.1% of the 1992-94 average of the state tourism expenditure total ($19,289.24 million /year). Excluding gambling expenses the 3-year average for 1992-94 for the Barrier Island component accounted for an estimated $786.9 million a year in 1992 dollars or 10.8% of the 3-year average of the 4-coastal county tourism expenditure ($7,265.8 million/year) and 4.8% of the 1992-94 average of state tourism spending without gambling ($16,392.93 million/year).

Recalling the earlier discussion about the misuse of economic impact measures, the usefulness of the Longwoods study is in the generation of projected direct expenditures discussed above and not in economic impact measures. Direct expenditures represent the closest activity to aggregate GNP estimates, because they represent the sales of final goods and services sold, and do not contain double-counting. Regarding coastal tourism, the Barrier Island component of the Longwoods study represents one component of beach travel and underestimates the importance and magnitude of tourism expenditure activity in the coastal region of New Jersey. To develop an estimate of expenditures associated with beach travel, similar estimates for day trips <u>and</u> other overnight trips (i.e., hotel/motel/resort, campgrounds-private and public, and those that stay with friends/relatives) for the four coastal counties are necessary. To give some idea of the magnitude of an upper bound of beach related expenses, an upper bound estimate based on all three components of beach travel (i.e., barrier island rentals, other overnight travel, and day trip travel) was developed. However, a word of caution regarding the interpretation and use of the estimates. The estimates were

Table 3.

Table 3 Cont.

Table 3 Cont.

developed for illustrative purposes rather than as a reliable point estimate. The estimates are based on two separate Longwoods survey studies, and hence, two different sampling bases, and there is some error from double-counting (i.e., from overlap of the two different sampling bases). As a result, the estimated travel expense probably overstates beach related travel expenses.

The Longwoods study for the 1993 season (Longwoods, Int'l. 1994a) was the only year in which the New Jersey Division of Travel and Tourism supplied complete information (i.e., all reports produced by Longwoods Int'l. for a particular year). The discussion that follows is based on the derivation in Table 4. One component of the tourist survey conducted by Longwoods International for the State of New Jersey, found that 12% of all overnight trips to New Jersey were beach trips, and 4% of all day trips were for beach trips (Longwoods Int'l. 1994b); this allowed a derivation of beach trips of 7.62 million trips in total in 1993 (steps 1 and 2, Table 4). An average trip expense was derived from projected total expenses and the estimated total number of trips by trip type (barrier island, other overnight, day) (step 3, Table 4). On the basis of the estimated number of trips and the estimated average trip expense, an estimate for expenditures of all beach related travel was developed at $2,095.877 million with gambling and $1,917.92 million without gambling (Table 4). The Barrier Island component represented 41.74% ($874.922M/$2095.877M) of the 1993 estimated tourist expenditures. If this proportion is representative across other years, the three-year (1992-94) estimated average expense for beach trips would account for an estimated $1,887.64 million ($787.9 million/.4174); similar estimates of tourism spending without gambling are 45.57% ($873.915M/$1917.91M) and $1,726.75 million without gambling. However, the reader is cautioned in reading too much into these estimates; they were developed for illustrative purposes. Little confidence can be placed in the estimates; such estimates should be developed from a single sample base rather than from two, and should be developed as part of an objective of the travel and tourism studies in the form of a range. The estimates developed are meant to illustrate the point that projected tourism expenses associated with beach trips based on the Barrier Island component are underestimates of such activity, while the county-level estimates of the four-coastal counties are overestimates. The derived estimate, $1,887.64 million per year over the 1992-94 period represents 18% of the four-coastal county three-year average, and 9.8% of the state three-year average (without gambling expenses the comparable estimate is $1,726.75 million/year representing 23.8% of the 4-coastal county 3-year average, and 10.5% of the 3-year state average) illustrating the fault with conclusions that the majority of the State of New Jersey's travel and tourism industry is generated from the Jersey Shore, but these statements and conclusions have appeared from time to time. Here, effort should be continued to develop expenses for all beach trips as an objective of the Longwoods studies.

Table 4.

Shore Protection Policy Oriented Studies

In this section two studies are discussed, the Shore Protection Master Plan for New Jersey, and a study conducted by ICF, Int'l. regarding assessments of alternative shore protection policies.

NJ Shore Protection Master Plan (1981). The 1981 New Jersey Shore Protection Master Plan (NJSPMP) prepared by Dames and Moore evaluated several alternative protection plans for the NJ shoreline based on a Cost-Benefit Analysis (CBA) (NJDEP, DCR 1981). The alternative plans evaluated in the Master Plan were classified as follows: 1) a Storm Erosion Protection alternative (i.e., nourishment equivalent to a 75' berm width with groins or a 100' berm width without groins); 2) a Recreation Development alternative (i.e., a berm width and beach width that would vary based on estimates of future recreational demand for beach use so as to provide a maximum of 100 sq. ft./person; either an increase or decrease in both berm and beach width compared to the Storm Erosion Protection alternative); 3) a Combination alternative (i.e., the maximum berm and beach width from the first two alternatives); 4) a Limited Restoration alternative (i.e., protection via nonstructural methods that would be greater than the level of protection from a Maintenance Program (which would yield the smallest protection level of all alternative plans), but smaller than the protection levels of the above three alternative plans); and 5) a Maintenance Program alternative (i.e., whereby the level of protection would be to repair and maintain existing physical structures in place, and to provide nourishment on an as-needed basis (i.e., to compensate for storm erosion), hence, the Maintenance Program can be treated as a reaction effort versus a preventative effort.

Parameters used in the CBA were a 50-year planning horizon (whereby the researchers developed some type of time plan for each alternative program as if each were carried out over a 50-year period including the maintenance, repair, construction of any new hard structures needed and any periodic nourishment to maintain and/or increase beach width), and a discount rate of 9%. It should be noted that only in the case of the Recreation Development alternative, the beach and berm width was estimated to increase with estimated recreation demand over time; in all other alternative plans beach and berm width was essentially held fixed over time (i.e., width was "stabilized" or controlled for processes of natural (long-term) erosion and storm (short-term) erosion).

Cost elements consisted of estimated Engineering costs (i.e., those costs necessary to implement each alternative plan), plus estimated Public Service costs (i.e., estimated costs for increased infrastructure capacity from future estimates of the demand for beach use associated with each alternative plan). Engineering cost estimates were developed over the 50-year planning period from projections of levels of engineering and labor effort needed to achieve each plan. Public Service cost estimates were based on the product of the projected number of future beach users (i.e., projected demand) and an average cost of infrastructure use estimated at $1/beach user.

Benefit elements consisted of estimated Recreational benefits (i.e., estimated benefits from the recreational use of the beach associated with each of the alternative plans), and Property Protection benefits (i.e., estimated benefits from protection of property associated with each of the alternative plans), both direct benefits attributable to beach protection. Recreational benefits were estimated from the product of the projected number of future beach users (i.e., an estimate of future demand) and the opportunity cost of beach use estimated at $2/day per user (which represented an average beach fee at the time). Property Protection benefits were based on the estimated value of losses that would have occurred without the plan in place for each of the alternative plans.

All estimated costs and benefits were discounted over the planning period, summed, and then a ratio of the discounted sum of benefits to that of costs, i.e., a B/C ratio, was calculated for each plan on a reach-by-reach basis.

Because the NJSPMP represents a basis from which all future shore protection plans will be developed, and that the emphasis was on the CBA of alternative plans, discussion of several limitations of the study are warranted. Being that the research team were mostly engineers, it is not surprising that so much emphasis and effort was placed on the cost estimates at the sacrifice of the benefit estimates. Estimates of the Engineering costs were probably highly accurate, reasonable, and probably varied over time. Limitations of the Engineering cost estimates, if any (since the exact costs were not given over all 50 years prior to discounting in the NJSPMP), would exist if consideration was not given to changes in prices and costs over time due to inflation and/or deflation. It is reasonable to expect that over 50 years, the costs of fuel to operate machinery would fluctuate and increase along with labor costs, etc. If these effects were not accounted for, the Engineering cost estimates presented could be greatly understated.

Public Service cost estimates could be limited due to two basic reasons, one associated with the projected future recreational use estimates, the other from the use estimate of $1/user. Here the rationale is that beach users use available public services to travel to and from the beach as well as at the beach and from using these services they derive benefits. However, many users may not be residents of the beach community and it is residents that pay for these local public services via property taxes. Thus, these costs must be estimated. Limitations of the estimates follow. First, forecasts of any variable(s) into future time periods are very sensitive to the specific model and variables used. Second, for any forecast some sensitivity analysis or a range of estimates associated with the errors of forecast or levels of confidence of the estimates is necessary to give perspective of the variability and reasonableness of the forecasts. Third, over time many variables regarding the Public Service cost estimate can change; the population and hence the number of future beach users, property values and property tax rates can increase, and the cost of providing public services or infrastructure generally increase over time. It is surprising that none of these points were discussed by the investigators in the NJSPMP. The accuracy of their forecasts of beach use is therefore suspect. Also, the use of a constant figure of $1/user over all 50 years is not reasonable and seriously erodes the validity of the estimates for Public Service costs. Again, the use of a constant figure over time will tend to understate these cost estimates, and misrepresent these costs.

More importantly, if both cost figures, Engineering costs and Public Service costs were underestimated and misrepresented, then any ratio of benefits to costs would favor the benefit side. Consider a simple ratio, a/b; to increase the value of the ratio one can either increase the numerator (a, which represents benefits here), or decrease the denominator (b, which represents costs here).

Consider the benefit measures. The measure of Recreational benefits was derived from the product of an estimated opportunity cost of beach use ($2/day per user) and an estimate of future use. As with Public Service costs there are two components of this estimate, and hence, two basic areas for limitations. The first is due to the estimates of future beach use, where the previous discussion concerning forecasts applies. The second basic reason concerns the use of opportunity costs as a benefit measure, the use of a constant figure across all beaches and protection projects in the state, and the use of a figure that does not change over time. Again, the researchers ignore these issues. Opportunity costs are not an appropriate measure of economic welfare as measured by the area under a demand curve above price, and do not represent economic benefits. The use of a constant value across different beaches and protection projects, means that either the researchers or the public perceive no differences among beaches located at Cape May versus those at Asbury Park, thus, benefits from beach use do not vary across beaches or projects for the same reasons. From a research perspective, in order to compare one alternative to another, ideally one would like to have some variation in the variables across projects, for example, variation in the marginal benefits across projects. Because there are physical differences across beaches along the Jersey Shore, and people have different tastes and preferences, one would expect that people should recognize these differences and choose to go to specific beaches. In turn, differences in these preferences should be reflected in values placed on benefits from beach use as seen in the Lindsay and Tupper (1989) study. Lastly, treatment of benefit estimates across time will tend to understate benefit estimates, and in turn, decrease the magnitude of a benefit-cost ratio. The researchers did not discuss any of these points.

Finally, consider the estimate of Property Protection benefits. This was derived from estimates of property value, not from actual property value or assessed property value available from tax assessors offices. The manner in which the researchers estimated these benefits was by first identifying what property would be lost or destroyed over a 50-year period if the protection plan were not implemented for each alternative plan. Then benefits were estimated from a product of the number of property structures that would be lost or destroyed by general type (business vs. residences) estimated over the 50-year period and an average value for the specific type of property structure. This estimate depends on two parts, one part involved a forecast, and the other part involved the use of an estimate of the average value for the type of property structure. Limitations concern both of these parts. First, the part based on forecasted or future estimates can pose problems and the above discussion regarding difficulties of forecasts is appropriate, mainly that the researchers should have provided some indication of the size of error or variability of the forecasted property lost, a level of confidence associated with the forecasts, and/or some type of sensitivity analysis. Second, the use of estimates rather than actual values can introduce biases into these benefit estimates.

In sum, the CBA performed in the NJSPMP is basically static, although some attempt was made to incorporate changes that occur over time, namely estimates of future beach use and estimates of future property lost or damaged. No attempt was made to incorporate any other dynamic elements nor the risk associated with the expected outcome of the projects, where one could introduce uncertainty into the derivation of net benefits (benefits less costs). A dynamic analysis would compare and contrast the monetary value of a projects' outcome if completely certain versus that with the presence of uncertainty. In the case of beach protection, possible risk factors could involve such effects as erosion and storm damage, that could cause any project from not being 100% completed, uncertainty over available funds to ensure 100% completion of any project over the planning period, and uncertainty over the estimated number of future beach users and the value of estimated future property structures lost versus protected. In addition, the effect of sea-level rise in the future would increase the risk and magnitude of erosion and storm damage. Probably the most serious fault is the problem of downward bias in both the cost and benefit estimates which would tend to introduce either an upward bias or a downward bias in the magnitude of the B/C ratio, respectively, distorting the B/C ratio. The net effect is ambiguous, but places concern over the validity and accuracy of the CBA in the NJSPMP.

ICF (1989). One of the only studies that examined policy options for areas within the coastal floodplain was conducted by ICF, Inc. (1989) for the New England/New York Coastal Zone Task Force of a study of coastal floodplain management. The objectives of the study were to determine the following: 1) costs and revenues associated with governmental entities as a result of development in the coastal floodplain; 2) costs and revenues of various policies targeted at coastal erosion and storm damage in the coastal floodplain; and 3) how these costs and revenues depend on sea-level rise. In regards to (1), revenues consisted of revenues from coastal development, tourism and recreation; costs were due to damages from erosion and storm-events, and from protective efforts. Specifically, revenues consisted of the sum of property taxes, income taxes, beach use fees, sales taxes, tolls, utility charges, accommodations taxes, and flood insurance premiums. Costs consisted of maintenance costs of local government services and infrastructure, maintenance costs of protective structures, fire protection, flood insurance claims, storm clean-up charges, costs of beach nourishment and dike building, and property acquisition.

The following policy options were evaluated: 1) no response, 2) beach nourishment only (to maintain the beach width, but not for protection of public and residential structures in close proximity to the beach), 3) dikes only (i.e., revetments or seawalls; the report is not clear), and 4) property acquisition (when damage in excess of 50% of the value for any structure occurred).

Two locations in New Jersey were examined as case studies, Ocean City and Strathmere, New Jersey. Results of the study indicated the following: 1) revenues to government entities from storm-event damage and protection were estimated at $114.4 million for Ocean City and $9.9 million for Strathmere in 1987; 2) costs due to damage and protective efforts were estimated at $130.6 million for Ocean City and at $3.2 million for Strathmere in 1987. The remainder of the study examined the effects of sea-level rise on the combined revenues lost and added costs for the above policy options at specific points in time, "snapshots" (i.e., 2025, 2050). Tables 5 and 6 contain these results for Ocean City and for Strathmere, respectively. ICF concluded the following: 1) the no-response option realized large losses and added costs in both "storm" and "non-storm" conditions over time; 2) the option of beach nourishment prevented substantial losses and added costs in "non-storm" conditions, but incurred large losses and costs in "storm" conditions because of washouts; 3) dike projects incurred large costs and losses in "non-storm" conditions reflecting one-time construction costs, and large losses and costs in "storm" conditions over time because of deterioration of dikes over time (i.e., their assumed lifespan appeared to be 25 years); and 4) the policy of property acquisition resulted in losses and costs of an order of magnitude higher in "storm" conditions reflecting one-time property costs, although over time revenue losses and added costs were less than all other policy alternatives (policies 1-3) under "storm" conditions. (It would be useful to know more about the effects of cumulative losses and added costs over time in these comparisons rather than the static approach taken here.) Similar remarks apply to Strathmere.

Policy findings of the study were the following: 1) "new" development in coastal floodplains was found to be a net cost to governments, "existing" development in many cases was worth protecting; 2) the "best" policy response was found to depend on the following factors a) the existing level of development, b) costs from damage, and c) magnitude of revenues gained; 2.a) in areas that are relatively less-developed, beach nourishment was found to be a viable policy; 2.b) in areas with high levels of development, protection via dikes was found to be a viable policy where large amounts of property could be damaged <u>and</u> where dike building could be coupled with a policy of halting further development; 3) optimal policies differed over time; and 4) the use of subsidies, e.g., NFIP, was found to have important consequences on development (in the promotion of development).

Table 5.

Table 6.

Policy recommendations offered by ICF were for two categories, 1) future development, and 2) existing development. Concerning future development, ICF recommended that: 1) continued large-scale development would be a net cost to governments (costs greater than revenues); 2) NFIP should tighten the availability of flood insurance to discourage future development (such action would have an effect similar to one where property owners are charged the full costs of flood insurance); 3) policies should be implemented whereby property owners are charged the full costs of cleanup and repairs; 4) policies should be designed to prohibit reconstruction of structures and land should be rezoned following significant storm damage (e.g., when 50% or more of a structure is damaged); and 5) governments should establish future policies on shore protection and announce these to the public (the idea, is that if governments pre-committ to a policy of <u>no</u> provision of shore protection in areas facing "new" development, this will create disincentives for future development and cause property-owners to internalize and bear the full costs of damage and cleanup).

Regarding existing development, ICF admits that policy choice "is not an easy answer," (ICF 1987:60). Recommended policy options were found to depend on development levels; in areas with high levels of development it was recommended that policies protect existing structures, whereas in areas with low levels of development, policies of protection were not recommended, but recommendations of property acquisition, rezoning, tightening of insurance, and having owners assume the full costs of damage and cleanup <u>and</u> accept losses of capital investment in buildings and from losses of the tax base were.

The main limitation of the study was that it contains only "snapshot" views, distinct years rather than cumulative effects over time; hence it is somewhat static, whereas the evaluation of tradeoffs among policies should be in an intertemporal context. Other limitations regard the derivations of added costs and lost revenues. Concerning lost revenues in property, sales and income taxes, it is not clear if all private households and residences located in the coastal communities in the study were included or if only those residences in close proximity to the beach were included in the analysis. Inclusion of income tax as a revenue item only makes sense for year-round residents and not for summer residents with a second home; again it is not clear why income taxes were used and who they pertain to in the study.

In general the ICF study is to be commended for the treatment of many complex issues involved with the provision of shore protection and in the examination of the tradeoffs among policy options. Investigators planning future policy oriented studies have much to gain from the ICF study.

Assessments of ACOE Projects

Two studies have been recently completed that examined overall ACOE projects and beach nourishment in general. One is a self-study conducted by the ACOE (U.S. ACOE 1994d), the other is an evaluation of national beach nourishment projects conducted by the National Academy of Sciences, National Research Council (NRC 1995).

ACOE (1994d) Self-Study. The ACOE self-study was the first phase of a two-part process that examined cost and beach fill comparisons of ACOE beach nourishment projects over the 1950-93 period, a total of 56 projects (the second part will examine the contribution of shore protection to economic development). The objective of the study was to determine how well the ACOE staff was able to estimate beach nourishment costs and beach fill actually needed. Results of the study indicated that total costs of these 56 projects were $670.259 million with $403.255 million as the federal cost share (in current dollars) or $1489.5 million with $881 million the federal share in 1993 dollars (these estimates are from the Executive Summary pg. xv; different figures are cited in the text as $1459.306 million and $850.712 million as the federal share in 1993 dollars, pg. 64). The amount of beach fill deposited was 167 million cubic yards (sum of fill from 39 of 49 beach restoration projects and 33 of 40 beach nourishment projects).

Comparisons of estimated versus actual costs and fill quantities were developed for 80% of the 56 projects. These comparisons indicated that actual costs were 4.4% less than the estimated project costs ($1340.9 million vs. $1403 million, actual vs. estimated, respectively in 1993 dollars). Regarding quantities of fill, comparisons indicated that actual quantities of fill were 5.4% greater than estimates of fill (158.4 million cu. yd. vs. 167 million cu. yd., estimated vs. actual). The second phase of the ACOE self-study will concentrate on benefits realized versus estimated benefits and the possible effects on development. Limitations of the study pertain to the selection of studies analyzed, and to the technique used to convert current dollar measures to 1993 dollar measures (constant dollars), the use of a non-conventional price index rather than a price index developed by the statistical branch of the federal government (e.g., wholesale price index such as the Producer Price Index).

NRC (1995) Study of Beach Nourishment. The NRC study (1995), convened a panel of experts to examine and evaluate beach nourishment projects in the U.S. Conclusions of the study were that beach nourishment was found to be a viable protection option to coastal communities and a boon to tourism. However, this depends on the following: if projects are well-designed, well-built, and provided in areas that experience relatively minor levels of erosion. In the past, many projects failed, the panel concluded. The panel recommended that projects need to be monitored and evaluated on a periodic basis, and recommended that future ACOE analyses incorporate risk and uncertainty into the economic and CB analyses as well as use the latest economic approaches (such as CV techniques based on referendum-type formats) (Bockstael 1995, NRC 1995).

Characteristics of Typical Beach Fill Projects in New Jersey

The following is meant to serve as a preliminary exercise to illustrate several points regarding economic analysis and CBA of shore protection projects covered earlier. The approach below examines typical beach fill projects on a reach basis (i.e., average characteristics of beach fill projects that were identified to have an estimated life span as estimated in the technical appendix), and benefits from shore protection are only based on the recreational use component. Because no other benefits are considered the analysis below is only hypothetical; its purpose is meant to illustrate application of techniques rather than an evaluation of tradeoffs among various beach fill projects or evaluation of alternative policy options.

The analysis that follows is based on past New Jersey shore protection projects for the cases of 1) beach fill, and 2) combined soft and hard protection. Average characteristics were developed to represent typical project efforts for these two categories. The information that was useful from past shore protection projects consists of: 1) the average size (amount of fill for beach nourishment projects); 2) the average cost; 3) the average actual life; and 4) the average expected life. Combined soft and hard protection projects were identified on the basis of occurrence of the type of project (hard vs. soft) within the same municipality or reach. For example, if a municipality had one or more hard protection projects <u>and</u> one or more beach fill projects completed within the 1960-94 period, these projects were treated as representative of combined protection efforts, case 2. Communities that did not have hard protection projects but did have beach fill projects completed in the 1960-94 period were treated as representative of scenarios of beach fill projects only, case 1. Communities that did not receive beach fill projects, but did have one or more hard protection projects completed during the 1960-94 period were treated as representative of hard protection only.

Costs of the project were assumed to be represented by the reported and estimated total costs associated with each project effort. Project costs are aggregate costs, costs could not be disaggregated into the components discussed in the NJSPMP because they were not recorded nor archived in this manner. Furthermore, project costs account for the final total cost of the project; project costs were not available on a monthly basis or any other time basis. Complications arise when projects cover one or more years from start to end when adjusting the costs to a constant dollar measure. In these situations, the year a project was completed was assumed to represent the year costs were measured in. For example, a project completed in 1967 was assumed to be measured in 1967 dollars.

Benefits that are considered are only recreational benefits. Economic impacts of tourism are not considered as benefits in this analysis because impacts do not measure the same economic effect as the economic value from beach use as pointed out in the second chapter, and contain double-counting. Furthermore, the use of trip expenditures developed from the beach tourism studies reflect the costs of taking a beach trip, the economic value from beach use is a economic value over and above these costs, a net value from beach use. The derivation of economic value was based on an average of economic values over all studies discussed in the literature review. Four values are measured, 1) the economic value without protection projects, 2) the value with protection projects, 3) the net economic value due to protection (value w <u>less</u> value w/o), and 4) the existence value from knowing a beach is preserved via protection. An important component of this derivation is information of beach use. Because information of beach attendance is not recorded, information of the number of beach tags sold (which is recorded) served as a proxy for beach use. Unfortunately, not all communities readily supplied beach tag sales for the 1960-94 period (see Appendix Table 2). The economic value of recreational beach use is estimated from the product of the average number of beach tags sold, the average economic value (a low of $.35/person per day and a high of $.39/person per day in 1992 dollars), and an estimate of the average actual life of a typical project.

Results are contained in Table 7. Conclusions that emerge from an examination of the illustrated data are that on the basis of costs and recreational benefits of a typical beach fill project in Reach 2 through Reach 14, benefits other than recreational benefits must be realized for a typical project to yield positive net benefits. On the basis of the estimated average lifespan of a typical project, a different set of conclusions is reached. Typical projects in Reach's 8 and 6 had the lowest lifespans, followed by typical projects in Reach's 2, and 3; typical projects in Reach's 10, 12, 9, 7, 4, and 14 had the longest average life (in descending order of years). However, because the average estimated life of a typical project differed as well as the scale of the project, economic analysis and CBA become complicated and must incorporate these elements into the analysis.

A hypothesis examined in this section was whether there were any differences in estimated average characteristics among typical beach fill projects if hard protection structures were present versus <u>no</u> presence of hard structures. Specific hypotheses were:

1) whether the estimated mean project cost was equal given the presence of hard structures versus their absence;

2) whether the estimated mean quantity of beach fill was equal given the presence of hard structures versus their absence; and

3) whether the estimated mean effective life was equal given the presence of hard structures versus their absence.

Preliminary results are contained in Table 8. Overall, a typical beach fill project combined with the presence of hard protection structures appeared to have a larger average amount of fill deposited (318,349 cu yds vs. 289726 cu yds), a higher average cost ($1,034,194 vs. $833,651), and a higher actual lifespan (12.9 yrs vs. 8.1 yrs). One possible explanation is that beach fill projects where hard protection structures are in place were typically larger soft protection projects (used

Table 7.

Table 8.

more fill and cost more), and the presence of hard protection structures appears to have increased the effective life of these beach fill projects possibly by lowering the erosion rate. Future papers need to explore this issue in more detail.

Policy Recommendations

Much of what follows regarding policy recommendations comes from the ICF study (1989) of coastal flood zones. Policy recommendations offered by ICF were for two categories, 1) future development, and 2) existing development. Concerning future development, ICF recommended that: 1) continued large-scale development would be a net cost to governments (costs greater than revenues); 2) NFIP should tighten the availability of flood insurance to discourage future development (such action would have an effect similar to one where property owners are charged the full costs of flood insurance); 3) policies should be implemented whereby property owners are charged the full costs of cleanup and repairs; 4) policies should be designed to prohibit reconstruction of structures and land should be rezoned following significant storm damage (50% or more); and 5) government should establish future policies on shore protection and announce these to the public (the idea, is that if governments pre-committ to a policy of <u>no</u> provision of shore protection in areas facing "new" development, this will create disincentives to future development and cause property-owners to internalize and bear the full costs of damage and cleanup).

Regarding existing development, ICF admits that policy choice "is not an easy answer," (ICF 1987: 60). Recommended policy options were found to depend on development levels; in areas with high levels of development is was recommended that policies protect existing structures, whereas in areas with low levels of development policies of protection were not recommended, but recommendations of property acquisition, rezoning, tightening of insurance, and having owners assume the full costs of damage and cleanup <u>and</u> accept losses of capital investment in buildings and from losses of the tax base were.

Summary

On the basis of the literature reviewed a brief summary follows. The basic issue one would like to address concerns whether the deposition of sand on the beach generates tourism and/or economic benefits. One can think of the coastal zone as a kind of "economic engine" in the sense that the coastal zone generates economic activity, such as income, sales, and jobs via tourism and businesses that are water-dependent and/or require to be located in close proximity to the coastal area. The above studies and investigators attempt to address different components of the beach fill

- economic activity question. However, because the above studies are based on different research and sampling designs, and have different objectives, the data and results are too fragmented for one to develop reliable estimates of economic activity. This means that the data from the literature are inadequate to develop point estimates of the magnitude of the economic activity associated with the coastal zone. Furthermore, studies that have tried to estimate the level of activity from coastal tourism have tended to ignore the effect of beach nourishment on coastal tourism activity. Data from the above coastal tourism studies are inappropriate to address the issue of whether beach nourishment projects on their own, generate economic activity. In order to isolate and address the issue, investigators must develop studies that incorporate research designs to isolate economic activity dependent on the coastal zone and/or on specific beach nourishment projects. Such studies may require data on economic activity and tourism expenditures that are location-specific, in terms of the relative proximity to the shoreline, and to beach nourishment projects, and be collected on a seasonal basis. Such data is sensitive and generally hard to collect. However, without it one may not be able to advance beyond the current level of analysis and findings.

Recommendations for Further Study

Recommendations for further study that were identified from this preliminary economic investigation comprise the following:

1) a variety of economic techniques such as CBA, Input-Output models, simulation models, risk-return models, and other relevant economic approaches needs to be explored to determine their relative importance and usefulness in policy-oriented studies of shore protection and in their assessment of tradeoffs among the policy options to determine whether or not all economic techniques provide similar policy recommendations (there is a possibility that different policy outcomes could result from different techniques because the techniques emphasize different criteria and information);

2) the building of pertinent databases, which involves the collection and development of appropriate data necessary to specific economic approaches will be dependent on the specific approach and can be a very lengthy process. Some of these data can be gathered from the respective ACOE districts (especially for inventory surveys of physical structures), some will involve statistics and data generated from the state government;

3) studies with research designs to isolate and identify economic activity dependent on the coastal zone and/or on specific beach nourishment projects. Such studies may require data on economic

activity and tourism expenditures that are location-specific, in terms of the relative proximity to the shoreline, and to beach nourishment projects, and be collected on a seasonal basis;

4) resources recommended for support of economic studies are estimated to be in the \$100,000 to \$150,000 range depending on the 1) time frame, 2) economic method, 3) range and detail of alternative policy options to be assessed, 4) treatment of risk and uncertainty, and 5) level of detail required of the data. However, such an estimate could quickly become a lower bound range involving a team approach of economists and expenses of \$75,000 - \$100,000/year for several years;

5) the ICF (1989) study is an exercise that demonstrates the complexity of the issues involved in public policy tradeoffs. However, this is the tip of the iceberg; an analysis should be intertemporal rather than static; performing an analysis that is intertemporal and involves many cost and benefit components is an extremely tedious and complex task; resources of time and funding must match the complexity of the problem;

6) the analysis must incorporate the elements and effects of uncertainty in benefit and cost estimates since these depend on the probability of storm occurrence as well as the magnitude of the storm; hence cost and benefit items are stochastic in nature and vary according to storm severity, time and sea-level rise;

7) the analysis must also incorporate the element of risk associated with project failure and outcome; and

8) the ICF (1989) study demonstrates that there are many more elements to consider regarding policy tradeoffs (level of development, future vs. existing development, level of erosion, storm-events, availability of flood insurance, who should bear the burden of flood insurance and that of cleanup and repair costs, land rezoning issues, reconstruction policies, and future shore protection policy stances); future analysis must be designed to incorporate these numerous and varied elements.

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U.S. ACOE. 1995. New Jersey Shore Protection Study: Barnegat Inlet to Little Egg Inlet. Reconnaissance Study, Philadelphia District, PA, March.

University of North Carolina. 1991. Evaluation of the National Coastal Zone Management Program. The Center for Urban and Regional Studies, Chapel Hill, NC, February.

Table 1. Analyses of the Economic Value of Recreational Beach Use.

Study:	Year/Area:	Sample Design:	Economic Method:		Results:				
Curtis & Shows (1982)	1981; FL	NA	Face-to-Face:		Residents	Tourists			
			CV-Open Ended	WTP	1.88	2.15			
Curtis & Shows (1984)	1983; FL	NA	Face-to-Face:		Residents	Tourists			
			CV-Open Ended	WTP	4.44	4.88			
Bell & Leeworthy (1986)	1984; FL	RS of	Telephone:		Residents:	Tourists:			
		911 residents;	CV-Open Ended	WTP	1.31	1.45			
		4333 tourists			(3.23)	(2.57)			
		contacted, 826	Face-to-Face:		n=804	n=968			
		surveyed	CV-Open Ended	%0-bids	29%	38%			
				TCM*:					
				CS	10.23	29.32			
				CV	10.31	29.45			
				EV	10.18	29.29			
				No.	870	1051			
Lindsay & Tupper (1988)	1988; NH & ME	RS of 1100 users	CV-Open Ended, Face-to-Face		All	Old Orchard	Pine Pt.	Ocean Park	Seabrook, NH
				CV	47.40	51.15	46.15	52.40	41.03
					(53.00)	(49.13)	(52.88)	(60.34)	(52.35)
					n=934	n=316	n=173	n=164	n=281
				CVEC*	30.80	20.08ab	27.37a	34.30a	40.45b
					(68.80)	(29.72)	(39.69)	(54.28)	(83.76)
					n=834	n=248	n=153	n=156	n=277
				CVLP*	26.40	26.31a	18.50a	20.16ab	34.47b
					(65.30)	(70.55)	(29.82)	(31.69)	(85.13)
					n=834	n=248	n=153	n=156	n=277

* Estimated from the area under an estimated linear demand curve evaluated at mean values of the independent variables.

*Differences significant at the .05 level.
Numbers in parentheses are standard deviations.

Table 1 Cont.

Study:	Year/Area:	Sample Design:	Economic Method:		Results:		
Silberman & Klock (1988)	1985; No. NJ	Split RS	CV-Iterative-Bidding; Face-to-Face		WTP w/o Project	WTP w Project	Existence Value
				Mean	3.60	3.90	16.31
				SD	(1.14)	(1.18)	(19.62)
				N	462	445	822
				%0 bids	17%	-	13%
				% protest bids	-	-	38.4%
Silberman, Gerlowski, Williams (1992)	1985 No. NJ	Split RS	Face-to-Face, CV-Iterative-Bidding			Existence Value: Total Sample	Existence Value: Nonzero Bidders
	Staten Is.	RS=500	Telephone, CV-Open Ended				
			Face-to-Face				
			Will Use in Future	Mean		15.21	23.59
				SD		(20.91)	(21.92)
				N		1177	
			%0 bids			35.5%	
			Will Not Use	Mean		9.34	21.02
				SD		(16.04)	(18.28)
				N		754	
			%0 bids			55.6%	
			Telephone				
			Will Use in Future	Mean		19.65	31.98
				SD		(38.37)	(44.00)
				N		83	
			%0 bids			38.6%	
			Will Not Use	Mean		9.51	23.87
				SD		(17.49)	(20.67)
				N		138	
			%0 bids			60.1%	
			Tobit Model:				
			Will Use in Future			15.10	
			Will Not Use			9.26	

Table 1 Cont.

Study:	Year/Area:	Sample Design:	Economic Method:	Results:		
US ACOE (1986)	1985; No. NJ	RS of 2917 users	CV-Iterative Bidding; Face-to-Face	WTP w/o Protection	3.67	
				WTP w 50'berm	3.89	
				WTP w 100' berm	3.93	
				Midpoint WTP w Prot.	3.91	
Koppel (1994) & Kucharski (1995)	1994; So. NJ	RS of 1063 users	Face-to-Face:		w/o $0-bids	w $0-bids
			CV-Closed Ended	WTP-Beach use	5.04	4.22
			CV-Open Ended	WTP-Wider beach	5.41	4.59
				Wider beach:		
				% WTP more	16%	
				% WTP less	3%	
				% WTP same	81%	

Summary:

	----------Results----------		
No. NJ	Use values:	1985$	1992$
(Silberman & Kloch 1988)	WTP w Protection	3.90	5.08
(Silberman et al. 1992)	WTP w/o Prot.	3.60	4.69
	Net Value - Prot.	0.30	0.39
	Non-Use values:		
	Existence value	9.26/92-days	12.07/92-days
	Sum Use & Non-use	0.4006	0.52

		1985$		1992$	
		w/o $0-bids	w $0-bids	w/o $0-bids	w $0-bids
So. NJ (Koppel 1994)	WTP - Wider beach	5.41	4.59	5.12	4.35
	WTP - Beach use	5.04	4.22	4.77	4.00
	Net value - Prot.	0.37	0.37	0.35	0.35

		1988$	1992$
NH-ME (Lindsay & Tupper 1988)	WTP - Beach use	47.40	56.21
	WTP - Protection	30.80/92-days=0.33	36.53/92-days=0.39

Table 1 Cont.

Study:	Year/Area:	Sample Design:	Economic Method:	Results:
Summary Cont.:				
			1985$	1992$
No. NJ (US ACOE 1986)	WTP-w/o Protection		3.67	4.78
	WTP-w 50′ berm		3.89	5.07
	WTP-w 100′ berm		3.93	5.12
	WTP w Protection		3.91	5.10
	Net value:			
	w Protection		0.24	0.315
	w 50′ berm		0.22	0.29
	w 100′ berm		0.26	0.34

Note: All estimates of economic value are in terms of $/person per day, except for estimates of existence value which was converted to $/person/day on the basis of 92-day season. Because of such high economic value estimates associated with the NH-ME study, net value of beach protection was estimated from the bid value for erosion control divided by 92-day season.

Symbols refer to the following: NA (Not Available), CV (Contingent Valuation), RS (Random Sample), WTP (Willingness-to-Pay), TCM (Travel Cost Model), CVEC (Contingent Valuation for Erosion Control), CVLP (Contingent Valuation for Litter Program), SD (standard Deviation), N (no. of observations).

Sources: see References at end of Chapter 3.

Table 2. Estimated Expenditures of Travel and Tourism in New Jersey, 1990-94.

OBS	TYPE	YR	CO	COST	COST92	NIND
1	County level	1990	Atlantic	6220.26	6407.51	NA
2	County level	1990	Cape May	1458.93	1502.85	NA
3	County level	1990	Monmouth	758.56	781.39	NA
4	County level	1990	Ocean	677.76	698.16	NA
5	County level	1991	Atlantic	5910.94	6088.88	4115.3
6	County level	1991	Cape May	1510.71	1556.19	2583.9
7	County level	1991	Monmouth	753.56	776.24	1990.3
8	County level	1991	Ocean	692.66	713.51	1990.3
9	County level	1992	Atlantic	6704.51	6509.64	NA
10	County level	1992	Cape May	1094.00	1062.20	NA
11	County level	1992	Monmouth	1262.67	1225.97	NA
12	County level	1992	Ocean	892.53	866.59	NA
13	County level	1993	Atlantic	6453.49	6265.91	4427.9
14	County level	1993	Cape May	1390.23	1349.82	5348.9
15	County level	1993	Monmouth	1055.93	1025.24	2107.9
16	County level	1993	Ocean	769.02	746.67	2107.9
17	County level	1994	Atlantic	6865.98	6499.98	3767.4
18	County level	1994	Cape May	2527.51	2392.78	5461.3
19	County level	1994	Monmouth	1683.21	1593.48	2356.2
20	County level	1994	Ocean	1484.84	1405.69	2356.2
21	Barrier Is. - Jersey Shore	1992	Atlantic	30.75	29.86	117.80
22	Barrier Is. - Jersey Shore	1992	Cape May	509.24	494.44	2488.70
23	Barrier Is. - Jersey Shore	1992	Monmouth	28.91	28.06	90.9
24	Barrier Is. - Jersey Shore	1992	Ocean	193.78	188.14	579.9
25	Barrier Is. - Jersey Shore	1993	Atlantic	32.62	31.67	110.7
26	Barrier Is. - Jersey Shore	1993	Cape May	605.01	587.42	2954.1
27	Barrier Is. - Jersey Shore	1993	Monmouth	29.86	29.00	94.0
28	Barrier Is. - Jersey Shore	1993	Ocean	207.43	201.40	621.4

Table 2 Cont.

OBS	TYPE	YR	CO	COST	COST92	NIND
29	Barrier Is. - Jersey Shore	1994	Atlantic	44.78	45.22	117.5
30	Barrier Is. - Jersey Shore	1994	Cape May	554.58	527.85	2881.0
31	Barrier Is. - Jersey Shore	1994	Monmouth	39.15	39.89	140.2
32	Barrier Is. - Jersey Shore	1994	Ocean	178.78	172.09	781.7

Note: COST is in millions of current dollars associated with the year of the study and refers to the projected expenditures on travel and tourism, COST92 is in millions of 1992 dollars adjusted by the relevent CPI index, NIND refers to the estimated number of visitors in thousands. NA refers to not available. Concerning NIND, estimates were not available on a county basis, only on a region basis, hence Ocean and Monmouth counties are considered as the Shore region (see Longwoods studies for details).

Source: 1990-91; Longwoods, Int'l. 1992. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1990-91. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, May.

1992-93; Longwoods, Int'l. 1994. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1992-93. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, September.

1994; Longwoods, Int'l. 1995. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1993-94. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, June.

Table 2 Cont.

OBS	TYPE	YR	COST	COST92	NIND
1	County level	1990	9115.51	9389.91	NA
2	County level	1991	8867.87	9134.82	8689.5
3	County level	1992	9953.71	9664.40	NA
4	County level	1993	9668.67	9387.64	11884.7
5	County level	1994	12561.54	11891.93	11584.9
6	Barrier Is. - Jersey Shore	1992	762.67	740.50	3277.3
7	Barrier Is. - Jersey Shore	1993	874.93	849.49	3780.2
8	Barrier Is. - Jersey Shore	1994	817.29	773.71	3920.4

Note: COST is in millions of current dollars associated with the year of the study and refers to the projected expenditures on travel and tourism, COST92 is in millions of 1992 dollars adjusted by the relevent CPI index, NIND refers to the estimated number of visitors in thousands. NA refers to not available. Concerning NIND, estimates were not available on a county basis, only on a region basis, hence Ocean and Monmouth counties are considered as the Shore region (see Longwoods studies for details).

Source: 1990-91; Longwoods, Int'l. 1992. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1990-91. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, May.

1992-93; Longwoods, Int'l. 1994. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1992-93. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, September.

1994; Longwoods, Int'l. 1995. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1993-94. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, June.

Table 3. Estimated Expenditures of Travel and Tourism in New Jersey without Gambling Expenditures, 1990-94.

OBS	TYPE	YR	CO	COST	COST92	NIND
1	County level	1990	Atlantic	3622.23	3731.27	NA
2	County level	1990	Cape May	1458.93	1502.85	NA
3	County level	1990	Monmouth	758.56	781.39	NA
4	County level	1990	Ocean	677.76	698.16	NA
5	County level	1991	Atlantic	3421.15	3524.14	4115.3
6	County level	1991	Cape May	1510.71	1556.19	2583.9
7	County level	1991	Monmouth	753.56	776.24	1990.3
8	County level	1991	Ocean	692.66	713.51	1990.3
9	County level	1992	Atlantic	3574.75	3470.85	NA
10	County level	1992	Cape May	1094.00	1062.20	NA
11	County level	1992	Monmouth	1262.67	1225.97	NA
12	County level	1992	Ocean	892.53	866.59	NA
13	County level	1993	Atlantic	3285.75	3190.25	4427.9
14	County level	1993	Cape May	1390.23	1349.82	5348.9
15	County level	1993	Monmouth	1055.93	1025.24	2107.9
16	County level	1993	Ocean	769.02	746.67	2107.9
17	County level	1994	Atlantic	3663.14	3467.87	3767.4
18	County level	1994	Cape May	2527.51	2392.78	5461.3
19	County level	1994	Monmouth	1683.21	1593.48	2356.2
20	County level	1994	Ocean	1484.84	1405.69	2356.2
21	Barrier Is. - Jersey Shore	1992	Atlantic	29.80	28.93	117.8
22	Barrier Is. - Jersey Shore	1992	Cape May	509.24	494.44	2488.7
23	Barrier Is. - Jersey Shore	1992	Monmouth	28.91	28.06	90.9
24	Barrier Is. - Jersey Shore	1992	Ocean	193.78	188.14	579.9
25	Barrier Is. - Jersey Shore	1993	Atlantic	31.62	30.70	110.7
26	Barrier Is. - Jersey Shore	1993	Cape May	605.01	587.42	2954.1
27	Barrier Is. - Jersey Shore	1993	Monmouth	29.86	29.00	94.0
28	Barrier Is. - Jersey Shore	1993	Ocean	207.43	201.40	621.4

Table 3 Cont.

OBS	TYPE	YR	CO	COST	COST92	NIND
29	Barrier Is. - Jersey Shore	1994	Atlantic	34.56	32.72	117.5
30	Barrier Is. - Jersey Shore	1994	Cape May	554.58	527.85	2881.0
31	Barrier Is. - Jersey Shore	1994	Monmouth	39.15	39.89	140.2
32	Barrier Is. - Jersey Shore	1994	Ocean	178.78	172.09	781.2

Note: COST is in millions of current dollars associated with the year of the study and refers to the projected expenditures on travel and tourism, COST92 is in millions of 1992 dollars adjusted by the relevent CPI index, NIND refers to the estimated number of visitors in thousands. NA refers to not available. Concerning NIND, estimates were not available on a county basis, only on a region basis, hence Ocean and Monmouth counties are considered as the Shore region (see Longwoods studies for details).

Source: 1990-91; Longwoods, Int'l. 1992. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1990-91. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, May.

1992-93; Longwoods, Int'l. 1994. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1992-93. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, September.

1994; Longwoods, Int'l. 1995. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1993-94. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, June.

Table 3 Cont.

OBS	TYPE	YR	COST	COST92	NIND
1	County level	1990	6517.48	6713.67	NA
2	County level	1991	6378.08	6570.08	8689.5
3	County level	1992	6823.95	6625.61	NA
4	County level	1993	6500.93	6311.98	11884.7
5	County level	1994	9358.70	8859.82	11584.9
6	Barrier Is. - Jersey Shore	1992	761.72	739.58	3277.3
7	Barrier Is. - Jersey Shore	1993	873.92	848.51	3780.2
8	Barrier Is. - Jersey Shore	1994	807.07	764.04	3920.4

Note: COST is in millions of current dollars associated with the year of the study and refers to the projected expenditures on travel and tourism, COST92 is in millions of 1992 dollars adjusted by the relevent CPI index, NIND refers to the estimated number of visitors in thousands. NA refers to not available. Concerning NIND, estimates were not available on a county basis, only on a region basis, hence Ocean and Monmouth counties are considered as the Shore region (see Longwoods studies for details).

Source: 1990-91; Longwoods, Int'l. 1992. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1990-91. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, May.

1992-93; Longwoods, Int'l. 1994. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1992-93. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, September.

1994; Longwoods, Int'l. 1995. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1993-94. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, June.

Table 4. Derivation of Estimated Expenditures of Beach Trips in New Jersey in 1993.

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1) Step 1:

Trip type	No.	%
Overnight	20.0M	13%
Day	130.5M	87%
Total	150.5M	100%

2) Step 2:

Trip purpose	No.*	%
Beach-Overnight	2.4M	12%
Beach-Day	5.22M	4%
Total-Beach	7.62M	

* Estimated based on % of (2) and from (1).

BARRIER IS. (RENTAL)

3) Step 3: Derivation of Average Expense (1993$):

Category:	Overnight	Day	Barrier Is.
Total expense	$10,924.8M	$6,461.91M	$874.922M
Total trips	20.0M	130.5M	(637,991.56*)
Avg. Exp. ($/trip)	$546.241	$49.517	$1371.368 JUST RENTAL
------------------- w/o Gambling -------------------			
Total expense	$9,862.5M	$4,377.75M	$873.915M
Avg. Exp. ($/trip)	$493.123	$33.546	$1369.792

(INCLUDED IN PREV TWO COLUMNS — SEPARATE SURVEY)

*3,780,100 persons/5.925 persons/trip = 637,991.56 trips.

4) Step 4: Derivation of Number of BEACH Trips:

Trip type BEACH	AT LEAST OVERNIGHT No.
Total-Overnight	2.4M
less Barrier Is.	-.638M
Other Overnight*	1.762M

*Overnight trips other than Barrier Is.

5) Step 5: Estimated Tourist Beach Expenses (1993$):

Category				
Barrier Is. trips:	.638M	@ $1371.368	=	$874.922M (RENTAL)
Other Overnight:	1.762M	@ $546.241	=	$962.476M
Day trips:	5.22M	@ $49.517	=	$258.479M

Estimated 1993 Beach-Related Expenses = $2,095.877M

------------------- w/o Gambling -------------------

Barrier Is. trips:	.638M	@ $1369.792	=	$873.915M
Other Overnight:	1.762M	@ $493.123	=	$868.883M
Day trips:	5.22M	@ $33.546	=	$175.11M

Estimated 1993 Beach-Related Expenses = $1,917.91M

Table 4 Cont.

Note: M refers to millions.

Source:

Expenses and Barrier Is. from:
Longwoods, Int'l. 1994a. The Economic Impact, Performance and Profile of the New Jersey Travel and Tourism Industry, 1992-93. Prepared for NJ Division of Travel and Tourism, Trenton, NJ, September.

Trip No. from:
Longwoods, Int'l. 1994b. The New Jersey 1993 Travel Research Program. Final Report to NJ Division of Travel and Tourism, Trenton, NJ, September.

Table 5. COMBINED REVENUE LOSS AND INCREASED COSTS RELATIVE TO 1987 FOR OCEAN CITY, NJ
(dollars)

Year/	No Response		Beach Nourishment (a)		Dike (b)		Property Acquisition(c)	
Sea Level Rise	Non-Storm	Storm	Non-Storm	Storm	Non-Storm	Storm	Non-Storm	Storm
2025:								
Linear	18,498,578	87,841,610	1,108,412	88,286,990	41,284,079	299,051	18,498,578	667,338,706
Mid-Low	23,045,581	93,358,730	2,463,138	97,053,793	42,062,207	299,051	23,045,581	772,692,035
Mid-High	26,060,507	111,688,471	3,263,657	122,239,897	45,077,133	299,051	26,060,507	838,690,128
2050:								
Linear	22,094,151	99,328,566	1,108,412	101,344,744	22,094,187	99,328,566	25,947,729	44,340,276
Mid-Low	28,547,967	115,419,783	2,929,374	128,788,189	28,547,967	115,419,783	31,217,619	53,758,775
Mid-High	31,746,387	155,047,215	3,958,614	181,381,048	31,746,387	155,746,215	33,679,370	63,526,340

(a) Beach nourishment is undertaken once every five years. Hence, to make the non-storm beach nourishment scenario's costs comparable to other yearly costs or revenues, the non-storm costs for this scenario should be divided by 5.

(b) Dike costs are listed in the non-storm column. These are one-time costs, so they should be compared with other one-time costs or annualized before comparing with ongoing yearly costs or revenues.

(c) Property acquisition costs are listed in the storm-related column. These are one-time costs, so they should be compared with other one-time costs or annualized before comparing with ongoing yearly costs or revenues.

Source: ICF, In'l. (1989).

Table 6. COMBINED REVENUES LOSS AND INCREASED COSTS RELATIVE TO 1987 FOR STRATHMERE, NJ
(dollars)

Year/ Sea Level Rise	No Response		Beach Nourishment (a)		Dike (b)		Property Acquisition(c)	
	Non-Storm	Storm	Non-Storm	Storm	Non-Storm	Storm	Non-Storm	Storm
2025:								
Linear	7,180,158	3,398,056	1,243,079	3,467,383	26,196,783	166,100	7,180,158	15,880,655
Mid-Low	7,244,709	3,051,422	2,762,397	3,467,383	26,261,334	166,100	7,244,709	14,382,069
Mid-High	7,379,172	2,435,740	3,660,176	3,674,045	26,395,798	166,100	7,379,172	10,741,090
2050:								
Linear	7,229,703	3,209,883	1,243,079	3,467,383	7,229,703	3,209,883	7,250,019	251,039
Mid-Low	7,547,735	2,077,930	2,762,397	3,674,045	7,547,735	2,077,930	7,559,744	222,899
Mid-High	7,735,464	1,389,266	3,660,176	4,061,535	7,735,464	1,389,266	7,742,383	210,577

(a) Beach nourishment is undertaken once every five years. Hence, to make the non-storm beach nourishment scenario's costs comparable to other yearly costs or revenues, the non-storm costs for this scenario should be divided by 5.

(b) Dike costs are listed in the non-storm column. These are one-time costs, so they should be compared with other one-time costs or annualized before comparing with ongoing yearly costs or revenues.

(c) Property acquisition costs are listed in the storm-related column. These are one-time costs, so they should be compared with other one-time costs or annualized before comparing with ongoing yearly costs or revenues.

Source: ICF Int'l. (1989).

Table 7. Average Characteristics of Typical Beach Fill Projects by Reach.

OBS	REACH	AQUAN	ACOST	ACOST92	AEXP	AACT
1	2	556352.56	1966168.98	2913342.35	5	4.4444
2	3	72500.00	57271.84	197044.57	5	6.0000
3	4	56598.92	68578.59	211607.15	5	10.5385
4	6	60660.00	50204.75	189570.92	5	2.3333
5	7	239043.72	256612.59	650296.03	5	12.5455
6	8	392500.00	503700.00	1937180.66	5	1.0000
7	9	279408.67	294302.82	793608.98	5	13.0000
8	10	581688.79	2261670.03	2771169.43	5	19.0000
9	11	333218.85	1435325.31	1776595.16	5	8.9000
10	12	239004.77	832364.34	915223.62	5	15.0000
11	14	200425.31	769394.43	1050722.92	5	10.2353

OBS	REACH	TAGS1	TSALES1	MTAGS1	HIGH	LOW
1	2	26553	108794	13276.50	5177.84	4646.78
2	3	722730	10240316	36136.50	14093.24	12647.78
3	4	6336820	31198170	162482.56	63368.20	56868.90
4	6	1484461	5826871	123705.08	48244.98	43296.78
5	7	671650	3652115	47975.00	18710.25	16791.25
6	8	256176	1940721	36596.57	14272.66	12808.80
7	9	166259	916620	33251.80	12968.20	11638.13
8	10	3136748	15905793	285158.91	111211.97	99805.62
9	11	279667	1780092	69916.75	27267.53	24470.86
10	12	113156	564571	56578.00	22065.42	19802.30
11	14	210971	1162257	21097.10	8227.87	7383.99

Note: AQUAN refers to the quantity of fill averaged over all projects completed within each reach, ACOST refers to the average cost of a project within each reach, ACOST92 refers to the average cost in 1992 dollars, AEXP refers to the average life of a project within each reach, AACT refers to the estimated average effective life of a project within each reach, TAGS1 refers to the total beach tags sold within each reach (for which data were present), TSALES1 refers to the total sales of beach tags sold within each reach, MTAGS1 refers to the average number of beach tags sold within each reach, HIGH refers to the high average estimated annual recreational benefits from beach protection (MTAGS1*$.39/person per day), LOW refers to the low average estimated annual recreational benefits from beach protection (MTAGS1*$.35/person per day).

Table 8. Examination of Presence of Hard Protection Structures Coupled with Typical Beach Fill Projects in New Jersey over 1960-94.

DHARD=0						
Variable	N	Sum	Mean	Variance	Std Dev	CV
DQUAN	24	6953421.00	289725.88	261893579452	511755.39	176.6343411
COST	24	20007633.20	833651.38	4.670894E12	2161225.12	259.2480693
COST92	24	31887138.78	1328630.78	6.600472E12	2569138.38	193.3673683
EXP	24	120.0000000	5.0000000	0	0	0
ACT	23	187.0000000	8.1304348	28.7549407	5.3623634	65.9542016

DHARD=1						
Variable	N	Sum	Mean	Variance	Std Dev	CV
DQUAN	119	37883513.58	318348.85	225637978496	475013.66	149.2116764
COST	119	123069120	1034194.29	4.7898335E12	2188568.83	211.6206651
COST92	119	166533985	1399445.25	5.5293462E12	2351456.19	168.0277377
EXP	119	595.0000000	5.0000000	0	0	0
ACT	119	1536.00	12.9075630	87.3049423	9.3437114	72.3894306

OBS	DHARD	AQUAN	ACOST	ACOST92	AEXP	AACT
1	0	289725.88	833651.38	1328630.78	5	8.1304
2	1	318348.85	1034194.29	1399445.25	5	12.9076

Note: DHARD=0 refers to no presence of hard protection structures, DHARD=1 refers to the presence of hard protection structures. AQUAN refers to the quantity of fill averaged over all projects completed within each reach, ACOST refers to the average cost of a project within each reach, ACOST92 refers to the average cost in 1992 dollars, AEXP refers to the average expected life of a project within each reach, AACT refers to the estimated average effective life of a project within each reach.

Source: Appendix Table 3.

Appendix Table 1. Estimated Expenditures of Travel and Tourism in New Jersey, 1987-94.

OBS	YR	CCODE	COST	COST92	NIND
12	1987*	Seasonal rent	1.7	2.10	6.0
13	1987	Daily rent	1.8	2.22	6.0
14	1987	Beach tag fees	58.0	71.63	6.0
15	1987	Parking fees	52.0	64.22	6.0
16	1987	Daytime entertainment	482.0	595.29	6.0
17	1987	Groceries	625.0	771.90	6.0
18	1987	Food & restaurant	612.0	755.84	6.0
19	1987	Nighttime entertainment	653.0	806.48	6.0
20	1987	Entertainment	1135.0	1401.76	6.0
21	1987	Gifts	224.0	276.65	6.0
22	1987	Total	6.2	7.66	6.0
23	1988*	Seasonal rent	1.2	1.42	4.8
24	1988	Daily rent	1.7	2.02	4.8
25	1988	Beach tag fees	43.0	51.00	4.8
26	1988	Parking fees	56.0	66.41	4.8
27	1988	Daytime entertainment	453.0	537.24	4.8
28	1988	Groceries	657.0	779.18	4.8
29	1988	Food & restaurant	466.0	552.66	4.8
30	1988	Nighttime entertainment	666.0	789.85	4.8
31	1988	Entertainment	1119.0	1327.10	4.8
32	1988	Gifts	191.0	226.52	4.8
33	1988	Total	5.4	6.40	4.8
34	1989*	Seasonal rent	2.0	2.26	5.7
35	1989	Daily rent	2.7	3.05	5.7
36	1989	Beach tag fees	33.0	37.34	5.7
37	1989	Parking fees	57.0	64.49	5.7
38	1989	Daytime entertainment	658.0	744.50	5.7
39	1989	Groceries	495.0	560.07	5.7
40	1989	Food & restaurant	477.0	539.70	5.7
41	1989	Nighttime entertainment	643.0	727.52	5.7
42	1989	Entertainment	1301.0	1472.02	5.7
43	1989	Gifts	279.0	315.68	5.7
44	1989	Total	7.4	8.37	5.7

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
			TYPE=County level			
1	1990[a]	Atlantic	Lodging	502.23	517.35	4115.3
2	1990	Atlantic	Food & restaurant	1186.94	1222.67	4115.3
3	1990	Atlantic	Entertainment	286.70	295.33	4115.3
4	1990	Atlantic	Automobile	584.83	602.44	4115.3
5	1990	Atlantic	Local transportation	36.19	37.28	4115.3
6	1990	Atlantic	Retail	1025.34	1056.21	4115.3
7	1990	Atlantic	Gambling	2598.03	2676.24	4115.3
8	1990	Cape May	Lodging	228.14	235.01	2583.9
9	1990	Cape May	Food & restaurant	502.51	517.64	2583.9
10	1990	Cape May	Entertainment	116.61	120.12	2583.9
11	1990	Cape May	Automobile	232.99	240.00	2583.9
12	1990	Cape May	Local transportation	14.48	14.92	2583.9
13	1990	Cape May	Retail	364.20	375.16	2583.9
14	1990	Cape May	Gambling	0.00	0.00	2583.9
15	1990	Monmouth	Lodging	78.66	81.03	1990.3
16	1990	Monmouth	Food & restaurant	277.74	286.10	1990.3
17	1990	Monmouth	Entertainment	54.93	56.58	1990.3
18	1990	Monmouth	Automobile	117.53	121.07	1990.3
19	1990	Monmouth	Local transportation	7.81	8.05	1990.3
20	1990	Monmouth	Retail	221.89	228.57	1990.3
21	1990	Monmouth	Gambling	0.00	0.00	1990.3
22	1990	Ocean	Lodging	69.83	71.93	1990.3
23	1990	Ocean	Food & restaurant	251.99	259.58	1990.3
24	1990	Ocean	Entertainment	51.60	53.15	1990.3
25	1990	Ocean	Automobile	105.09	108.25	1990.3
26	1990	Ocean	Local transportation	6.56	6.76	1990.3
27	1990	Ocean	Retail	192.69	198.49	1990.3
28	1990	Ocean	Gambling	0.00	0.00	1990.3
29	1991[a]	Atlantic	Lodging	473.82	488.08	4115.3
30	1991	Atlantic	Food & restaurant	1121.24	1154.99	4115.3
31	1991	Atlantic	Entertainment	270.65	278.80	4115.3
32	1991	Atlantic	Automobile	552.30	568.93	4115.3
33	1991	Atlantic	Local transportation	34.19	35.22	4115.3

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
34	1991	Atlantic	Retail	968.95	998.12	4115.3
35	1991	Atlantic	Gambling	2489.79	2564.74	4115.3
36	1991	Cape May	Lodging	236.84	243.97	2583.9
37	1991	Cape May	Food & restaurant	518.82	534.44	2583.9
38	1991	Cape May	Entertainment	120.32	123.94	2583.9
39	1991	Cape May	Automobile	241.36	248.63	2583.9
40	1991	Cape May	Local transportation	15.08	15.53	2583.9
41	1991	Cape May	Retail	378.29	389.68	2583.9
42	1991	Cape May	Gambling	0.00	0.00	2583.9
43	1991	Monmouth	Lodging	78.74	81.11	1990.3
44	1991	Monmouth	Food & restaurant	275.43	283.72	1990.3
45	1991	Monmouth	Entertainment	54.63	56.27	1990.3
46	1991	Monmouth	Automobile	116.83	120.35	1990.3
47	1991	Monmouth	Local transportation	7.76	7.99	1990.3
48	1991	Monmouth	Retail	220.17	226.80	1990.3
49	1991	Monmouth	Gambling	0.00	0.00	1990.3
50	1991	Ocean	Lodging	72.99	75.19	.
51	1991	Ocean	Food & restaurant	256.58	264.30	.
52	1991	Ocean	Entertainment	52.90	54.49	.
53	1991	Ocean	Automobile	107.57	110.81	.
54	1991	Ocean	Local transportation	6.71	6.91	.
55	1991	Ocean	Retail	195.91	201.81	.
56	1991	Ocean	Gambling	0.00	0.00	.
57	1992[b]	Atlantic	Lodging	657.72	638.60	.
58	1992	Atlantic	Food & restaurant	1198.31	1163.48	.
59	1992	Atlantic	Entertainment	247.67	240.47	.
60	1992	Atlantic	Automobile	567.37	550.88	.
61	1992	Atlantic	Local transportation	42.56	41.32	.
62	1992	Atlantic	Retail	861.12	836.09	.
63	1992	Atlantic	Gambling	3129.76	3038.79	.
64	1992	Cape May	Lodging	237.20	230.31	.
65	1992	Cape May	Food & restaurant	385.26	374.06	.
66	1992	Cape May	Entertainment	71.07	69.00	.
67	1992	Cape May	Automobile	170.57	165.61	.

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
68	1992	Cape May	Local transportation	13.98	13.57	.
69	1992	Cape May	Retail	215.92	209.64	.
70	1992	Cape May	Gambling	0.00	0.00	.
71	1992	Monmouth	Lodging	87.42	84.88	.
72	1992	Monmouth	Food & restaurant	432.78	420.20	.
73	1992	Monmouth	Entertainment	107.97	104.83	.
74	1992	Monmouth	Automobile	202.58	196.69	.
75	1992	Monmouth	Local transportation	10.29	9.99	.
76	1992	Monmouth	Retail	421.63	409.38	.
77	1992	Monmouth	Gambling	0.00	0.00	.
78	1992	Ocean	Lodging	58.30	56.61	.
79	1992	Ocean	Food & restaurant	317.35	308.13	.
80	1992	Ocean	Entertainment	77.51	75.26	.
81	1992	Ocean	Automobile	142.02	137.89	.
82	1992	Ocean	Local transportation	6.96	6.76	.
83	1992	Ocean	Retail	290.39	281.95	.
84	1992	Ocean	Gambling	0.00	0.00	.
85	1993[b]	Atlantic	Lodging	662.23	642.98	4317.20
86	1993	Atlantic	Food & restaurant	1112.83	1080.48	4317.20
87	1993	Atlantic	Entertainment	214.59	208.35	4317.20
88	1993	Atlantic	Automobile	517.68	502.63	4317.20
89	1993	Atlantic	Local transportation	41.62	40.41	4317.20
90	1993	Atlantic	Retail	736.80	715.38	4317.20
91	1993	Atlantic	Gambling	3167.74	3075.67	4317.20
92	1993	Cape May	Lodging	243.79	236.70	2394.80
93	1993	Cape May	Food & restaurant	476.75	462.89	2394.80
94	1993	Cape May	Entertainment	102.50	99.52	2394.80
95	1993	Cape May	Automobile	220.59	214.18	2394.80
96	1993	Cape May	Local transportation	15.40	14.95	2394.80
97	1993	Cape May	Retail	331.20	321.57	2394.80
98	1993	Cape May	Gambling	0.00	0.00	2394.80
99	1993	Monmouth	Lodging	90.18	87.56	1392.50
100	1993	Monmouth	Food & restaurant	372.69	361.86	1392.50
101	1993	Monmouth	Entertainment	84.00	81.56	1392.50

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
102	1993	Monmouth	Automobile	166.83	161.98	1392.50
103	1993	Monmouth	Local transportation	9.65	9.37	1392.50
104	1993	Monmouth	Retail	332.58	322.91	1392.50
105	1993	Monmouth	Gambling	0.00	0.00	1392.50
106	1993	Ocean	Lodging	59.94	58.20	1392.50
107	1993	Ocean	Food & restaurant	281.80	273.61	1392.50
108	1993	Ocean	Entertainment	63.02	61.19	1392.50
109	1993	Ocean	Automobile	120.58	117.08	1392.50
110	1993	Ocean	Local transportation	6.60	6.41	1392.50
111	1993	Ocean	Retail	237.08	230.19	1392.50
112	1993	Ocean	Gambling	0.00	0.00	1392.50
113	1994[d]	Atlantic	Lodging	645.75	611.33	6365.90
114	1994	Atlantic	Food & restaurant	1216.34	1151.50	6365.90
115	1994	Atlantic	Entertainment	263.74	249.68	6365.90
116	1994	Atlantic	Automobile	578.98	548.12	6365.90
117	1994	Atlantic	Local transportation	41.38	39.17	6365.90
118	1994	Atlantic	Retail	916.95	868.07	6365.90
119	1994	Atlantic	Gambling	3202.84	3032.11	6365.90
120	1994	Cape May	Lodging	649.49	614.87	8984.10
121	1994	Cape May	Food & restaurant	722.93	684.39	8984.10
122	1994	Cape May	Entertainment	179.68	170.10	8984.10
123	1994	Cape May	Automobile	331.99	314.29	8984.10
124	1994	Cape May	Local transportation	18.14	17.17	8984.10
125	1994	Cape May	Retail	625.28	591.95	8984.10
126	1994	Cape May	Gambling	0.00	0.00	8984.10
127	1994	Monmouth	Lodging	451.39	427.33	1344.26
128	1994	Monmouth	Food & restaurant	451.39	427.33	1344.26
129	1994	Monmouth	Entertainment	113.77	107.71	1344.26
130	1994	Monmouth	Automobile	210.15	198.95	1344.26
131	1994	Monmouth	Local transportation	10.33	9.78	1344.26
132	1994	Monmouth	Retail	446.18	422.40	1344.26
133	1994	Monmouth	Gambling	0.00	0.00	1344.26
134	1994	Ocean	Lodging	404.50	382.94	1279.52
135	1994	Ocean	Food & restaurant	404.50	382.94	1279.52
136	1994	Ocean	Entertainment	101.57	96.16	1279.52

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
137	1994	Ocean	Automobile	180.26	170.65	1279.52
138	1994	Ocean	Local transportation	8.42	7.97	1279.52
139	1994	Ocean	Retail	385.59	365.04	1279.52
140	1994	Ocean	Gambling	0.00	0.00	1279.52
------------------------TYPE=Barrier Is. - Jersey Shore ------------------------						
141	1992b	Atlantic	Lodging	18.310	17.778	117.8
142	1992	Atlantic	Food & restaurant	4.756	4.618	117.8
143	1992	Atlantic	Entertainment	2.648	2.571	117.8
144	1992	Atlantic	Automobile	0.603	0.586	117.8
145	1992	Atlantic	Local transportation	.	.	117.8
146	1992	Atlantic	Retail	3.481	3.380	117.8
147	1992	Atlantic	Gambling	0.951	0.923	117.8
148	1992	Cape May	Lodging	363.275	352.716	2488.7
149	1992	Cape May	Food & restaurant	62.265	60.456	2488.7
150	1992	Cape May	Entertainment	13.732	13.333	2488.7
151	1992	Cape May	Automobile	11.734	11.393	2488.7
152	1992	Cape May	Local transportation	.	.	2488.7
153	1992	Cape May	Retail	58.233	56.540	2488.7
154	1992	Cape May	Gambling	0.000	0.000	2488.7
155	1992	Monmouth	Lodging	20.619	20.020	90.9
156	1992	Monmouth	Food & restaurant	3.534	3.431	90.9
157	1992	Monmouth	Entertainment	0.779	0.757	90.9
158	1992	Monmouth	Automobile	0.666	0.647	90.9
159	1992	Monmouth	Local transportation	.	.	90.9
160	1992	Monmouth	Retail	3.305	3.209	90.9
161	1992	Monmouth	Gambling	0.000	0.000	90.9
162	1992	Ocean	Lodging	138.233	134.215	579.9
163	1992	Ocean	Food & restaurant	23.693	23.004	579.9
164	1992	Ocean	Entertainment	5.225	5.073	579.9
165	1992	Ocean	Automobile	4.465	4.335	579.9
166	1992	Ocean	Local transportation	.	.	579.9
167	1992	Ocean	Retail	22.159	21.515	579.9
168	1992	Ocean	Gambling	0.000	0.000	579.9

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
169	1993[b]	Atlantic	Lodging	19.460	18.894	110.7
170	1993	Atlantic	Food & restaurant	5.032	4.886	110.7
171	1993	Atlantic	Entertainment	2.802	2.721	110.7
172	1993	Atlantic	Automobile	0.638	0.620	110.7
173	1993	Atlantic	Local transportation	.	.	110.7
174	1993	Atlantic	Retail	3.684	3.577	110.7
175	1993	Atlantic	Gambling	1.006	0.977	110.7
176	1993	Cape May	Lodging	431.595	419.050	2954.1
177	1993	Cape May	Food & restaurant	73.975	71.825	2954.1
178	1993	Cape May	Entertainment	16.314	15.840	2954.1
179	1993	Cape May	Automobile	13.941	13.535	2954.1
180	1993	Cape May	Local transportation	.	.	2954.1
181	1993	Cape May	Retail	69.185	67.174	2954.1
182	1993	Cape May	Gambling	0.000	0.000	2954.1
183	1993	Monmouth	Lodging	21.303	20.684	94.0
184	1993	Monmouth	Food & restaurant	3.651	3.545	94.0
185	1993	Monmouth	Entertainment	0.805	0.782	94.0
186	1993	Monmouth	Automobile	0.688	0.668	94.0
187	1993	Monmouth	Local transportation	.	.	94.0
188	1993	Monmouth	Retail	3.415	3.316	94.0
189	1993	Monmouth	Gambling	0.000	0.000	94.0
190	1993	Ocean	Lodging	147.972	143.671	621.4
191	1993	Ocean	Food & restaurant	25.362	24.625	621.4
192	1993	Ocean	Entertainment	5.593	5.431	621.4
193	1993	Ocean	Automobile	4.780	4.641	621.4
194	1993	Ocean	Local transportation	.	.	621.4
195	1993	Ocean	Retail	23.720	23.030	621.4
196	1993	Ocean	Gambling	0.000	0.000	621.4
197	1994[c]	Atlantic	Lodging	21.297	20.161	117.5
198	1994	Atlantic	Food & restaurant	5.461	5.170	117.5
199	1994	Atlantic	Entertainment	3.087	2.922	117.5
200	1994	Atlantic	Automobile	0.698	0.661	117.5
201	1994	Atlantic	Local transportation	.	.	117.5
202	1994	Atlantic	Retail	4.018	3.804	117.5

Appendix Table 1 Cont.

OBS	YR	CO	CCODE	COST	COST92	NIND
203	1994	Atlantic	Gambling	10.216	9.671	117.5
204	1994	Cape May	Lodging	395.086	374.025	2881.0
205	1994	Cape May	Food & restaurant	68.118	64.487	2881.0
206	1994	Cape May	Entertainment	14.909	14.114	2881.0
207	1994	Cape May	Automobile	12.745	12.065	2881.0
208	1994	Cape May	Local transportation	.	.	2881.0
209	1994	Cape May	Retail	63.724	60.327	2881.0
210	1994	Cape May	Gambling	0.000	0.000	2881.0
211	1994	Monmouth	Lodging	27.886	26.400	140.2
212	1994	Monmouth	Food & restaurant	4.808	4.552	140.2
213	1994	Monmouth	Entertainment	1.052	0.996	140.2
214	1994	Monmouth	Automobile	0.900	0.852	140.2
215	1994	Monmouth	Local transportation	.	.	140.2
216	1994	Monmouth	Retail	4.498	4.258	140.2
217	1994	Monmouth	Gambling	0.000	0.000	140.2
218	1994	Ocean	Lodging	127.366	120.576	.
219	1994	Ocean	Food & restaurant	21.960	20.789	.
220	1994	Ocean	Entertainment	4.806	4.550	.
221	1994	Ocean	Automobile	4.109	3.890	.
222	1994	Ocean	Local transportation	.	.	.
223	1994	Ocean	Retail	20.543	19.448	.
224	1994	Ocean	Gambling	0.000	0.000	.

Appendix Table 1 Cont.

Note: COST is in millions of current dollars associated with the year of the study and refers to the projected expenditures on travel and tourism, COST92 is in millions of 1992 dollars adjusted by the relevent CPI index, NIND refers to the estimated number of visitors in millions for the 1987-89 period and in thousands for the 1990-94 period. Regarding the 1992 tourism expenditure estimates from the Longwoods study, the 1992 estimates under the COST column are in 1993 dollars and had to be deflated to express them in 1992 dollars under the COST92 column. Concerning NIND, estimates were not available on a county basis, only on a region basis, hence Ocean and Monmouth counties are considered as the Shore region (see Longwoods studies for details).

Source:

*1988-89; Opinion Research Corporation, 1989.

[a]1990-91; Longwoods Int'l, 1992.

[b]1992-93; Longwoods Int'l, 1994.

[c]1994; Longwoods Int'l, 1995.
(see References in Chapter 3.)

Appendix Table 2. Historical Beach Use Data for Selected Municipalities, NJ, 1970-94.

OBS	PLACE	YR	TAGS	TSALES
	------------------CO=Atlantic ------------------			
1	Brigantine City	1985	39352	162464
2	Brigantine City	1986	38204	158645
3	Brigantine City	1987	40541	168959
4	Brigantine City	1988	34857	182621
5	Brigantine City	1989	33393	173303
6	Brigantine City	1990	34115	180884
7	Brigantine City	1991	35714	186928
8	Margate City	1987	35058	165359
9	Margate City	1988	34381	172661
10	Ventnor City	1986	33500	200700
11	Ventnor City	1987	32500	195900
12	Ventnor City	1988	30820	182000

Appendix Table 2 Cont.

OBS	PLACE	YR	TAGS	TSALES
	CO=Cape May			
13	Cape May City	1987	84907	403922
14	Cape May City	1988	87603	410888
15	Cape May Point Borough	1987	6143	44481
16	Cape May Point Borough	1988	5667	41208
17	Cape May Point Borough	1989	4354	41885
18	Cape May Point Borough	1990	4373	41239
19	Cape May Point Borough	1991	4540	42461
20	Cape May Point Borough	1992	4413	41833
21	Cape May Point Borough	1993	4707	43506
22	Cape May Point Borough	1994	4264	50834
23	Ocean City	1984	312710	1237429
24	Ocean City	1985	316687	1258194
25	Ocean City	1986	310286	1246508
26	Ocean City	1987	311924	1545718
27	Ocean City	1988	261931	1352368
28	Ocean City	1989	233560	1252579
29	Ocean City	1990	282830	1341451
30	Ocean City	1991	282055	1364229
31	Ocean City	1992	245094	1541383
32	Ocean City	1993	298896	1900872
33	Ocean City	1994	280775	1865062
34	Sea Isle City	1991	67966	415227
35	Sea Isle City	1992	63351	428976
36	Sea Isle City	1993	74372	466766
37	Sea Isle City	1994	73978	469123
38	Stone Harbor Borough	1987	71000	306000
39	Stone Harbor Borough	1988	42156	258571

Appendix Table 2 Cont.

OBS	PLACE	YR	TAGS	TSALES
	----------------------CO=Monmouth ----------------------			
40	Asbury Park City	1986	65670	248833
41	Asbury Park City	1987	45470	205868
42	Asbury Park City	1988	19155	91431
43	Avon by the Sea Borough	1986	28677	449745
44	Avon by the Sea Borough	1987	34103	476362
45	Avon by the Sea Borough	1988	28486	326362
46	Belmar Borough	1970	174141	366127
47	Belmar Borough	1971	190013	393996
48	Belmar Borough	1972	165680	359547
49	Belmar Borough	1973	178062	386042
50	Belmar Borough	1974	164631	429612
51	Belmar Borough	1975	177996	465029
52	Belmar Borough	1976	192605	488661
53	Belmar Borough	1977	222514	627608
54	Belmar Borough	1978	227703	643877
55	Belmar Borough	1979	203366	581885
56	Belmar Borough	1980	293849	926557
57	Belmar Borough	1981	278969	911624
58	Belmar Borough	1982	310165	1131061
59	Belmar Borough	1983	402596	1428545
60	Belmar Borough	1984	299700	1567363
61	Belmar Borough	1985	320301	1949498
62	Belmar Borough	1986	151225	1751054
63	Belmar Borough	1987	140919	1684960
64	Belmar Borough	1988	98259	1225692
65	Belmar Borough	1989	144970	1052101
66	Belmar Borough	1990	230344	949596
67	Belmar Borough	1991	271043	1211972
68	Belmar Borough	1992	234203	1064808
69	Belmar Borough	1993	284249	1370331
70	Belmar Borough	1994	248611	1264013
71	Belmar Borough	1995	253332	1262456

Appendix Table 2 Cont.

OBS	PLACE	YR	TAGS	TSALES
	----------------------CO=Monmouth	---------------------		
72	Bradley Beach Borough	1986	65060	418484
73	Bradley Beach Borough	1987	62713	504061
74	Bradley Beach Borough	1988	32829	380867
75	Long Branch City	1987	35971	126979
76	Long Branch City	1988	18717	72227
77	Long Branch City	1989	25343	85428
78	Long Branch City	1990	24552	86432
79	Long Branch City	1991	40762	144684
80	Long Branch City	1992	28868	104093
81	Long Branch City	1993	35474	118799
82	Long Branch City	1994	30567	105388
83	Manasquan Borough	1986	73479	932202
84	Manasquan Borough	1987	70764	905910
85	Manasquan Borough	1988	57052	823572
86	Neptune Township	1986	53208	379812
87	Neptune Township	1987	34125	314000
88	Neptune Township	1988	12980	177240
89	Sea Bright Borough	1987	15078	61722
90	Sea Bright Borough	1988	11475	47072
91	Sea Girt Borough	1985	19368	312088
92	Sea Girt Borough	1986	16018	339018
93	Sea Girt Borough	1987	15492	350875
94	Sea Girt Borough	1988	13528	323404
95	Sea Girt Borough	1989	29134	237010
96	Sea Girt Borough	1990	29992	268900
97	Sea Girt Borough	1991	40325	310060
98	Sea Girt Borough	1992	34041	290148
99	Sea Girt Borough	1993	42476	295040
100	Sea Girt Borough	1994	35705	315928

Appendix Table 2 Cont.

OBS	PLACE	YR	TAGS	TSALES
	----------------------CO=Ocean	-----	-----	-----
101	Berkeley Township	1992	8890	37029
102	Berkeley Township	1993	9418	33572
103	Berkeley Township	1994	5409	24607
104	Brick Township	1987	12687	66980
105	Brick Township	1988	9429	61917
106	Dover Township	1987	2090	6270
107	Dover Township	1988	1614	4842
108	Harvey Cedars Borough	1986	11635	64526
109	Harvey Cedars Borough	1987	10588	76860
110	Harvey Cedars Borough	1988	9124	67142
111	Long Beach Township	1986	87267	277435
112	Long Beach Township	1987	80769	375082
113	Long Beach Township	1988	74385	346236
114	Seaside Heights Borough	1986	498905	1789535
115	Seaside Heights Borough	1987	450551	1689981
116	Seaside Heights Borough	1988	272779	744694
117	Seaside Park Borough	1987	131492	785469
118	Seaside Park Borough	1988	81197	581975
119	Ship Bottom Borough	1992	62668	255684
120	Ship Bottom Borough	1993	54597	274444
121	Ship Bottom Borough	1994	46862	310851
122	Ship Bottom Borough	1995	77051	467644
123	Surf City Borough	1992	38573	248734
124	Surf City Borough	1993	44790	289201
125	Surf City Borough	1994	37165	299276
126	Surf City Borough.	1995	36176	299000

Note: TAGS refers to the number of beach tags sold, TSALES the revenue from beach tags sold.

Source: Obtained from individual municipalities.

Appendix Table 3. Average Characteristics of Typical Beach Fill Projects by Reach and Presence of Hard Protection Structures Delineation.

OBS	REACH	DHARD	AQUAN	ACOST	ACOST92	AEXP	AACT
1	2	0	651024.71	2455468.99	3468778.02	5	5.0000
2	2	1	225000.00	253618.93	969317.50	5	2.5000
3	3	1	72500.00	57271.84	197044.57	5	6.0000
4	4	0	80231.20	101463.27	308193.00	5	8.8000
5	4	1	41828.75	48025.67	151240.99	5	11.6250
6	6	0	60660.00	50204.75	189570.92	5	2.3333
7	7	1	239043.72	256612.59	650296.03	5	12.5455
8	8	1	392500.00	503700.00	1937180.66	5	1.0000
9	9	0	279408.67	294302.82	793608.98	5	13.0000
10	10	1	581688.79	2261670.03	2771169.43	5	19.0000
11	11	1	333218.85	1435325.31	1776595.16	5	8.9000
12	12	1	239004.77	832364.34	915223.62	5	15.0000
13	14	0	38000.00	172699.00	272395.05	5	11.5000
14	14	1	222082.02	848953.82	1154499.97	5	10.0667

Note: DHARD=0 refers to no presence of hard protection structures, DHARD=1 refers to the presence of hard protection structures. AQUAN refers to the quantity of fill averaged over all projects completed within each reach-DHARD combination, ACOST refers to the average cost of a project within each reach-DHARD combination, ACOST92 refers to the average cost in 1992 dollars, AEXP refers to the average expected life of a project within each reach-DHARD combination, AACT refers to the estimated average effective life of a project within each reach-DHARD combination.